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The document identifies ANGRC attempt to assess possible Installation Restoration Program sites at The station. The process involves research via personal interviews, record searchs, review historic data, assessing "As Built Drawings", Aerial photographs, and a site visit.

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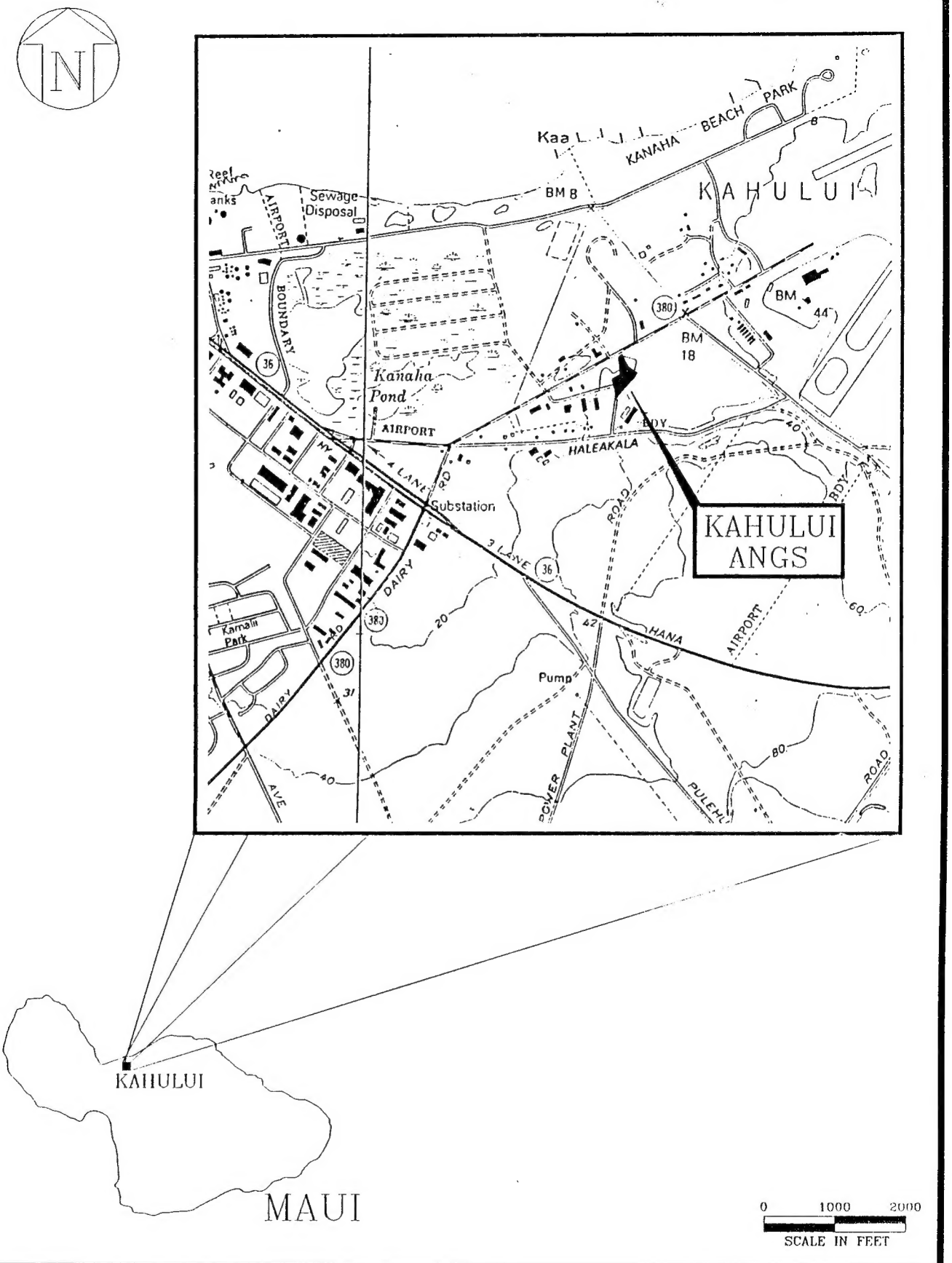
INSTALLATION RESTORATION PROGRAM (IRP) PRELIMINARY ASSESSMENT OF THE 292ND COMBAT COMMUNICATIONS SQUADRON

292ND COMBAT COMMUNICATIONS SQUADRON
KAHULUI AIR NATIONAL GUARD STATION
HAWAII AIR NATIONAL GUARD
KAHULUI, MAUI, HAWAII

JANUARY 1995

AIR NATIONAL GUARD READINESS CENTER
ANDREWS AFB, MARYLAND



INSIDE FRONT COVER

R. KAHALUI SITE

INSTALLATION LOCATION MAP

292nd Combat Communications Squadron
Hawaii Air National Guard
Kahului, Maui, Hawaii

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OPERATIONAL TECHNOLOGIES CORPORATION

JANUARY 1995

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INSTALLATION RESTORATION PROGRAM (IRP) PRELIMINARY ASSESSMENT OF THE 292nd COMBAT COMMUNICATIONS SQUADRON

292nd COMBAT COMMUNICATIONS SQUADRON
KAHULUI AIR NATIONAL GUARD STATION
HAWAII AIR NATIONAL GUARD
KAHULUI, MAUI, HAWAII

JANUARY 1995

Prepared For

AIR NATIONAL GUARD READINESS CENTER
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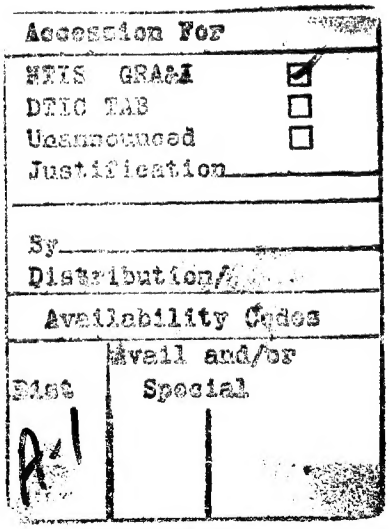
TABLE OF CONTENTS

TABLE OF CONTENTS (Concluded)



LIST OF FIGURES

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LIST OF TABLES

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LIST OF ACRONYMS

AFB	Air Force Base
ANG	Air National Guard
ANGRC/CEVR	Air National Guard Readiness Center Installation Restoration Programs Branch
ANGS	Air National Guard Station
AOC	Area of Concern
ARARs	Applicable or Relevant and Appropriate Requirements
CBCS	Combat Communications Squadron
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DERP	Defense Environmental Restoration Program
DLNR	Department of Land and Natural Resources
DoD	Department of Defense
DOTA	Department of Transportation, Airports Division (Hawaii)
DQO	Data Quality Objectives
ECAMP	Environmental Compliance Assessment and Management Program
EO	Executive Order
FFS	Focused Feasibility Study
FS	Feasibility Study
HM/HW	Hazardous Materials/Hazardous Waste
IRP	Installation Restoration Program
MOGAS	Motor gasoline
MSDS	Material Safety Data Sheet
MSL	Mean sea level
NPL	National Priorities List
OpTech	Operational Technologies Corporation
PA	Preliminary Assessment
PL	Public Law
QA/QC	Quality Assurance/Quality Control
RA	Risk Assessment
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
R&D	Research and Development
RI	Remedial Investigation
RM	Reemdial Measure
SARA	Superfund Amendments and Reauthorization Act of 1986
SCS	Soil Conservation Service
SI	Site Investigation
USAF	United States Air Force

LIST OF ACRONYMS (Concluded)

USC	United States Code
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey
UST	Underground Storage Tank

INSTALLATION RESTORATION PROGRAM
PRELIMINARY ASSESSMENT

EXECUTIVE SUMMARY

A. Introduction

The Air National Guard Readiness Center (ANGRC), Installation Restoration Programs Branch (CEVR) has the responsibility for managing the Installation Restoration Program (IRP) on all property the Air National Guard (ANG) maintains. In April 1994, the Preliminary Assessment (PA) for the 292nd Combat Communications Squadron (CBCS), Kahului Air National Guard Station (ANGS), Kahului, Maui County, Hawaii (also referred to as the Station) was initiated by personnel from the ANGRC/CEVR. Operational Technologies Corporation (OpTech) of San Antonio, Texas, was tasked by the ANGRC/CEVR to conduct the Preliminary Assessment at the Station. The PA included:

- An on-site visit, conducted by OpTech and ANGRC personnel on April 18 and 19, 1994, including interviews with both Station personnel and knowledgeable personnel at Hickam Air Force Base (AFB) and Fort Ruger;
- The acquisition and analysis of pertinent information and records on hazardous materials use and hazardous waste generation and disposal at the Station;
- The acquisition and analysis of available geologic, hydrologic, meteorologic, and environmental data from pertinent Federal, State, and local agencies; and
- An assessment of the Station to determine if areas of concern (AOCs) exist which may have been contaminated with hazardous materials/hazardous wastes (HM/HW).

B. Major Findings

Past activities at the Kahului ANGS involved the use and disposal of materials and wastes which could be categorized as hazardous. The major operations of the Station that use and dispose of HM/HW include motor vehicle maintenance, fuels management, corrosion control, power

production and the paint shop and battery shop. Wastes generated by these activities include waste oils, spent fuels, cleaning solvents, paint wastes, and thinners.

Interviews were conducted with seven present and one former Station personnel, in addition to knowledgeable personnel at Hickam AFB and Fort Ruger. As a result of these interviews and a field survey, one potential area of contamination was identified as a result of past vehicle and equipment maintenance and/or storage activities.

C. Conclusions

No Areas of Concern (AOCs) were identified at Kahului ANGS.

D. Recommendations

No further IRP investigation is warranted since no formal Areas of Concern have been identified.

SECTION 1.0 INTRODUCTION

1.1 BACKGROUND

This Preliminary Assessment (PA) covers the 292nd Combat Communications Squadron (CBCS), Hawaii Air National Guard, Kahului Air National Guard Station (ANGS), Kahului Airport, Kahului, Maui. The Station was constructed in 1983 and some operations at the Station over the ensuing 11 years have involved the use and disposal of materials and wastes which could be categorized as hazardous. Consequently, the Air National Guard Readiness Center (ANGRC) initiated the Installation Restoration Program (IRP) at the 292nd Combat Communications Squadron (CBCS). Coordination of the IRP at the Station is the responsibility of the 154th Group Environmental Management Office located at Hickam Air Force Base (AFB), Oahu, Hawaii. Operational Technologies Corporation (OpTech) was tasked by the ANGRC to conduct a PA at Kahului ANGS.

1.2 INSTALLATION RESTORATION PROGRAM (IRP)

The IRP is a comprehensive program designed to:

- Identify and fully evaluate suspected problems associated with past hazardous waste disposal and/or spill locations on Department of Defense (DoD) installations; and

- Control hazards to human health, welfare, and the environment that may have resulted from these past practices.

During June 1980, the DoD issued a Defense Environmental Quality Program Policy Memorandum (DEQPPM 80-6) requiring the identification of past hazardous waste disposal sites on DoD installations. The policy was issued in response to the Resource Conservation and Recovery Act (RCRA) of 1976 and in anticipation of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law (PL) 96-510 of 1980, commonly known as "Superfund." In August 1981, the President delegated certain authority specified under CERCLA to the Secretary of Defense through an Executive Order (EO 12316). As a result of EO 12316, the DoD revised the IRP by issuing DEQPPM 81-5 on December 11, 1981, which reissued and amplified all previous environmental directives and memoranda.

Although the DoD IRP and the U.S. Environmental Protection Agency's (USEPA) Superfund Programs were essentially the same, differences in the definition of program activities and lines of authority existed. These differences were rectified with the passage of the Superfund Amendments and Reauthorization Act (SARA, PL-99-499) of 1986. On January 23, 1987, a Presidential Executive Order (EO 12580) was issued which effectively revoked EO 12316 and implemented the changes promulgated by SARA.

The most important changes put into effect by the SARA legislation include:

- Section 120 of SARA provides that Federal facilities, including those within the DoD, are subject to all provisions of CERCLA/SARA concerning site assessment, evaluation under the National Contingency Plan (40 CFR 300), listing on the National Priorities List (NPL), and removal/remedial actions. The DoD must therefore comply with regulations and criteria promulgated by USEPA under Superfund authority.

- Section 211 of SARA also provides continuing statutory authority for the DoD to conduct its IRP as part of the Defense Environmental Restoration Program (DERP). The statutory authority was emplaced by adding Chapter 160, Sections 2701 - 2707 to Title 10, United States Code (10 USC 160).

- SARA also stipulates that terminology used to describe or to otherwise identify actions carried out under the IRP shall be substantially the same as the terminology of the regulations and guidelines issued by the USEPA under their Superfund authority.

As a result of SARA, the operational activities of the IRP are currently defined and described in the following section and are illustrated in Figure 1.1.

1.3 PURPOSE

The purpose of this Preliminary Assessment under the IRP is to identify and evaluate suspected problems associated with past waste handling procedures, disposal sites, and spill sites on Kahului ANGS property.

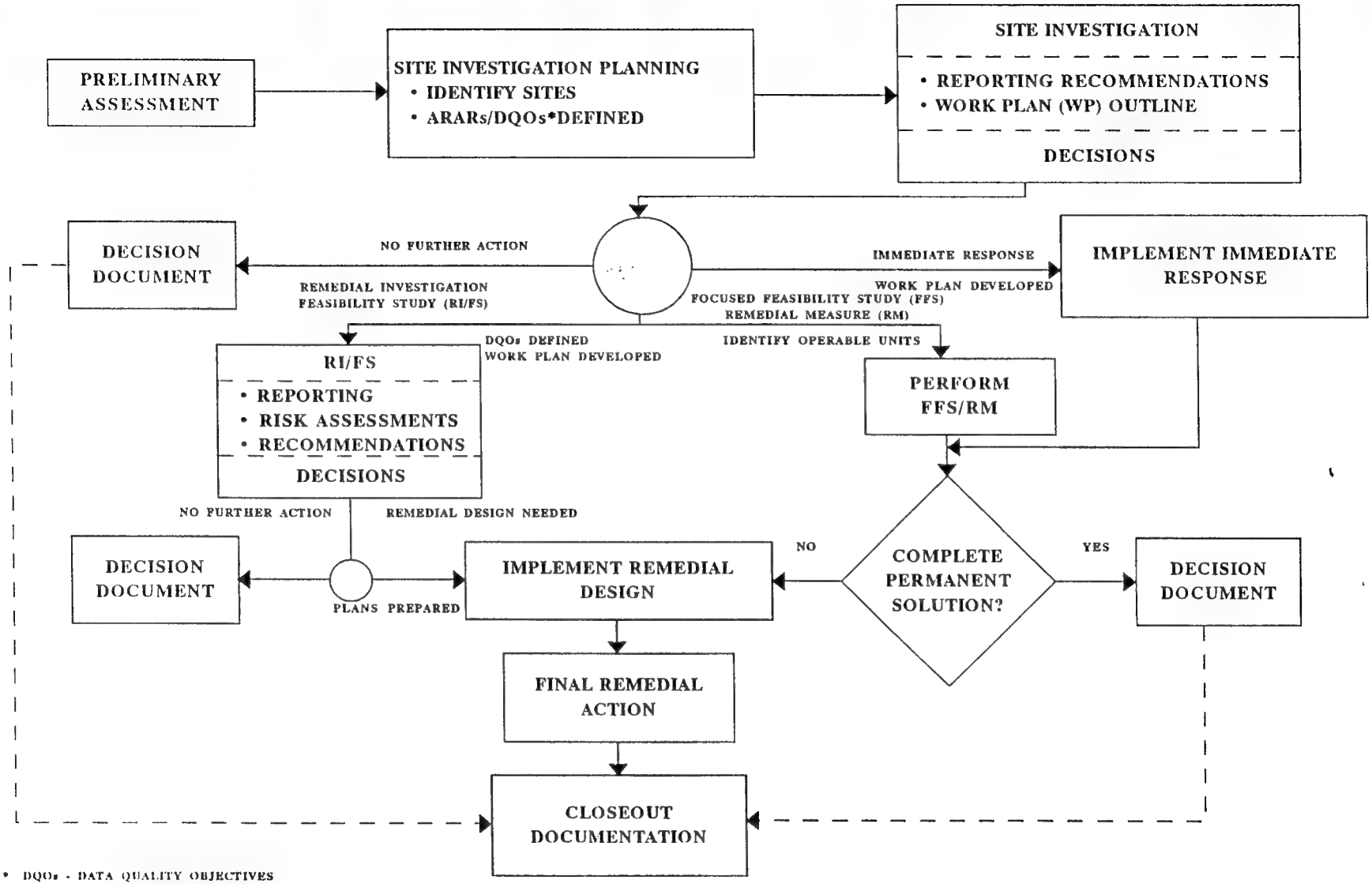

FIGURE 1.1

FORMS\ LANDSCAP

FLOW OF INSTALLATION RESTORATION PROGRAM TASKS
292nd Combat Communications Squadron
Kahului Air National Guard
Kahului, Maui, Hawaii

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The potential for migration of hazardous contaminants was evaluated by visiting the Station, reviewing existing environmental data, analyzing Station records concerning the use and disposal of hazardous materials and the generation of hazardous wastes, conducting interviews with current and past Station personnel who have knowledge of historical waste handling and disposal techniques and practices, and screening available sources to obtain preliminary data concerning the suspected contamination. Additionally, available information within the public domain was gathered to obtain sufficient data to establish the environmental setting for Kahului ANGS.

1.4 SCOPE

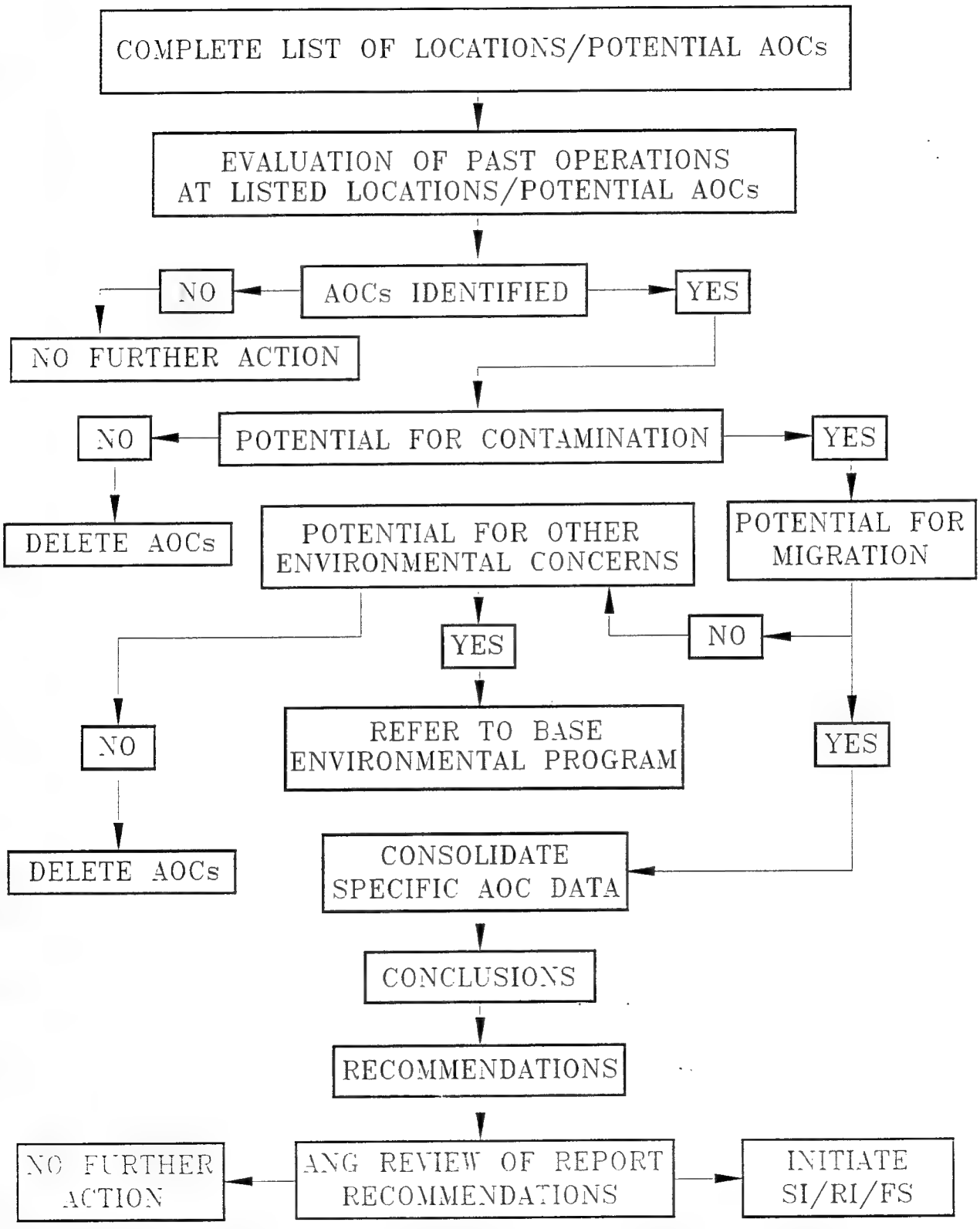
The scope of the PA was limited to the identification of sites at and under the primary control of the Station and the evaluation of potential receptors. The PA included:

- An on-site visit on April 18 and April 19, 1994;
- Interviews with eight current Station personnel, with an average tenure of 11 years, and interviews with knowledgeable personnel at Hickam AFB and Fort Ruger.
- The acquisition of records and information on past and present hazardous materials use, waste handling practices, and waste disposal on Kahului ANGS; and
- The acquisition of available information such as geological, hydrological, meteorological, land use and zoning, critical habitat, and related data from Federal, State, and local agencies.

1.5 METHODOLOGY

The PA began with an inbriefing with key Hawaii Air National Guard leaders to explain the purpose of the PA and to solicit their support during the information gathering phases. Mission support operations that may have used hazardous materials were given questionnaires to fill out listing estimated quantities of HM/HW historically used in their shops and methods of disposal. Figure 1.2 is a flow chart of the PA methodology.

DECISION TREE



SOURCE ANGRC SEVR. 1993

FIGURE 1.2

FORM: PAMCADI3

PRELIMINARY ASSESSMENT METHODOLOGY CHART
292nd Combat Communications Squadron
Hawaii Air National Guard
Kahului, Maui, Hawaii

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DECEMBER 1994

Detailed geological, hydrological, and meteorological data, and population, land use, and environmental data for the area surrounding Kahului ANGS were obtained from appropriate Federal, State, and local agencies. A listing of outside agencies contacted is included in Appendix A.

SECTION 2.0 INSTALLATION DESCRIPTION

2.1 LOCATION

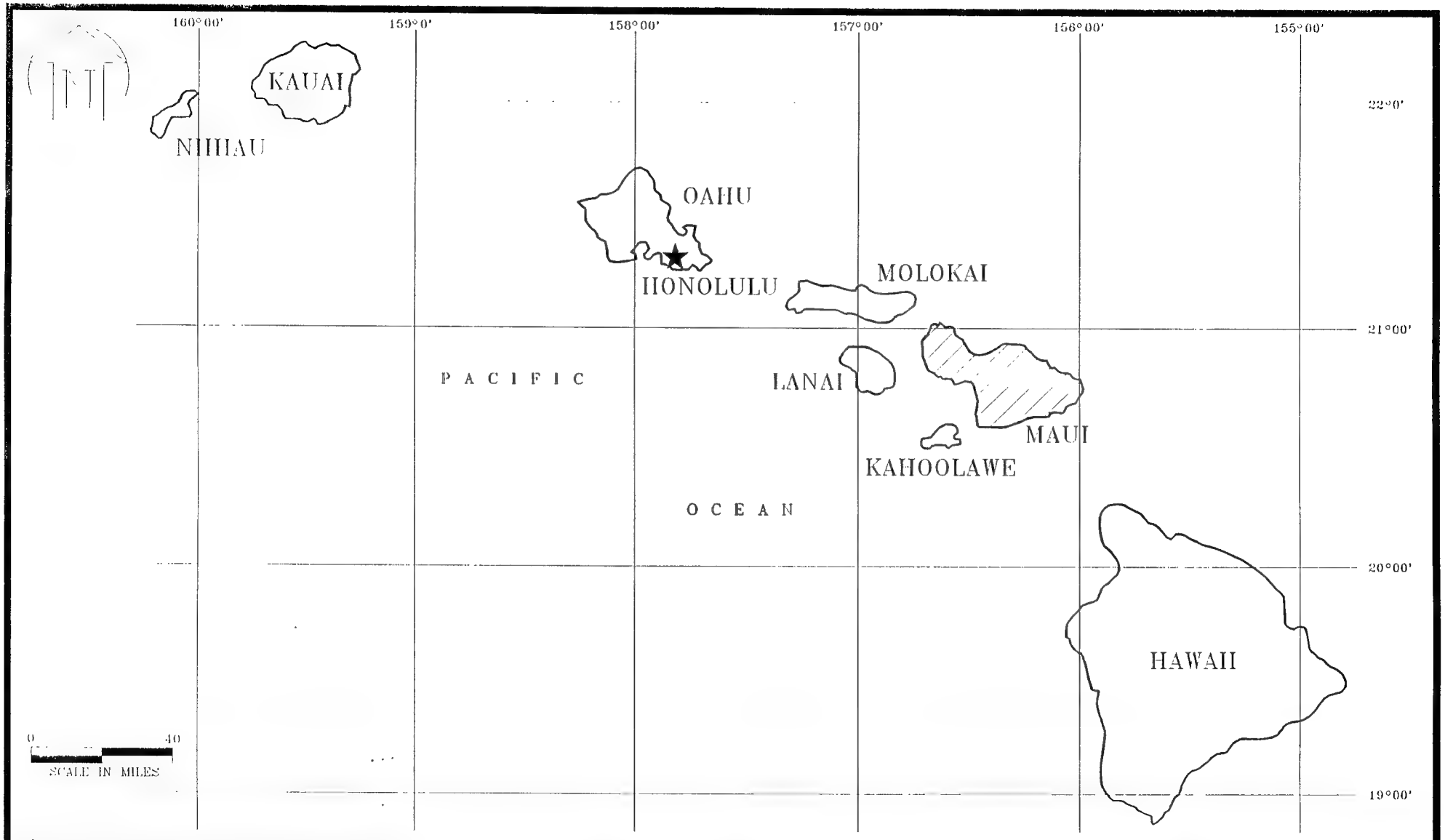
Maui, the state's second largest island, is 48 miles long, 26 miles wide, and covers 728 square miles (Figure 2.1). The Kahului ANGS is located at approximately 20°54' North latitude by 156°27' West longitude and is less than a mile northeast of the city of Kahului (Figure 2.2). According to the 1990 U.S. census, the population of Kahului is 16,889, while the population of the entire island (Maui County) is 100,374. Kahului ANGS, a 4.99-acre parcel, is located at 75 Kuleana Street on the western edge of Kahului Airport.

2.2 ORGANIZATION AND HISTORY

The Kahului ANGS was constructed in 1983 and completed in 1984. The Station property is leased from the State of Hawaii under a Federal lease agreement. Although the Station property had been undeveloped for some time prior to construction in 1983-84, the Kahului Airport property was the site of a U.S. Naval Air Station during World War II. Prior to the construction of the 1,350-acre U.S. Naval Air Station during the war years, the property consisted of cultivated sugar cane land, a residential area, and pastureland containing swamps and fish ponds. Construction of the Naval Air Station began in 1942-43, and, in addition to the runways, the Naval Station contained ancillary support facilities such as hangars, machine and metal shops, a battery shop, a carburetor shop, a radio/radar shop, both aboveground and underground fuel storage tanks, shooting ranges, a sewage-disposal plant, water mains, an electrical distribution system, a drainage system, warehouses, theater buildings, supply buildings, and barracks. In 1949, the Naval Air Station was transferred to the Territory of Hawaii. During 1954-56, the Naval Air Station at Puunene was closed, and all operations transferred to the Kahului location. The airfield itself became a commercial airport in 1954, and in 1956 the air terminal opened and passenger and commercial carriers located on the property.

The 292nd CBCS installation was built on a site that formerly contained three two-story wooden officers' quarters during the World War II period. Aerial photographs dated April 1954 and March 1972 clearly show the three barrack structures still in place on the site.

The 292nd CBCS's mission is to provide command and control communications and terminal traffic control facilities for tactical air forces and support of emergency U. S. Air Force (USAF)



SOURCE SOIL SURVEY OF THE ISLAND OF HAWAII, STATE OF HAWAII, 1973.

FIGURE 2.1

HILO\ISLANDS

LOCATION OF THE ISLAND OF MAUI
IN THE STATE OF HAWAII
292nd Combat Communications Squadron
Kahului Air National Guard Station
Kahului, Maui, Hawaii

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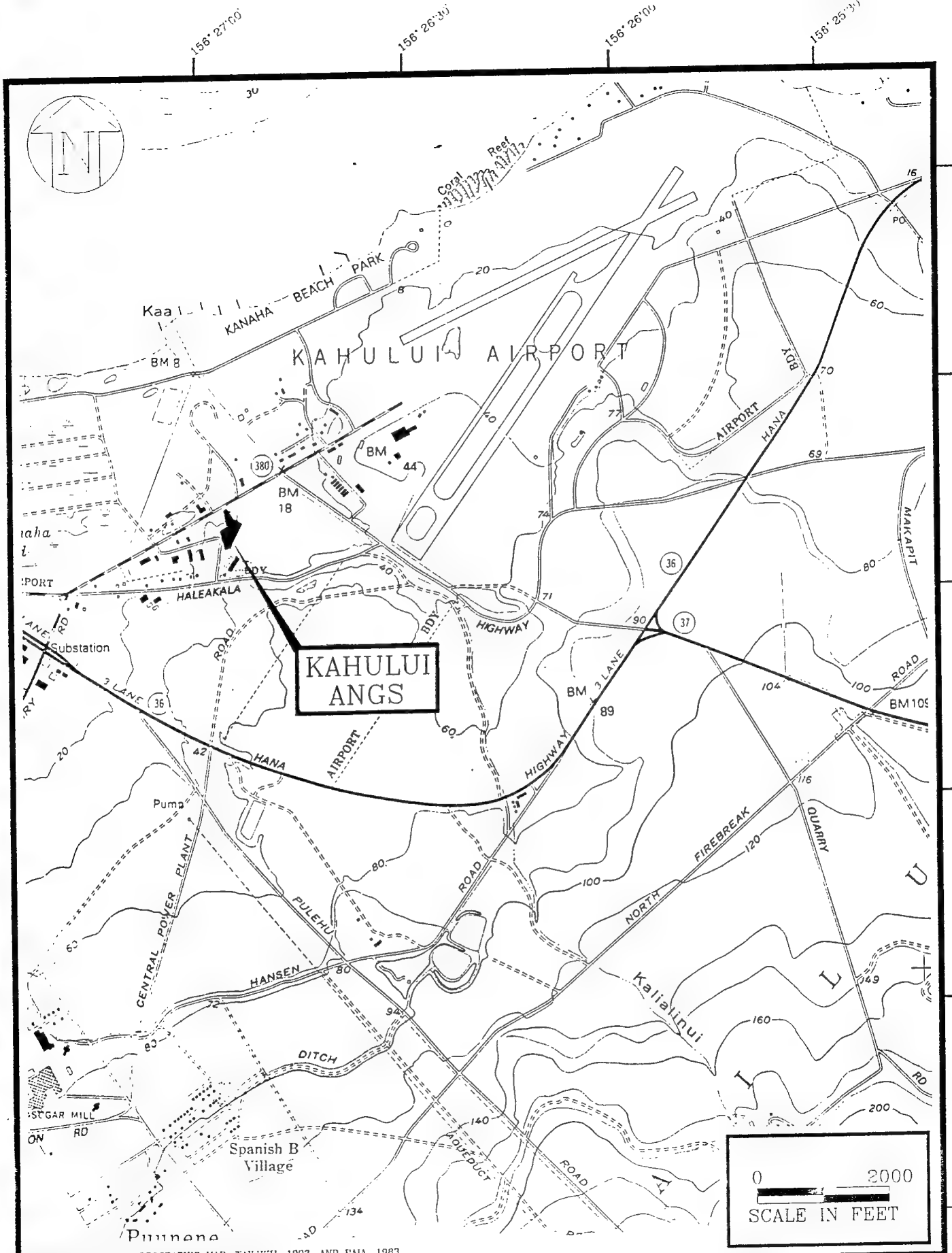

...OTTAGE GROVE 7.5 TOPOGRAPHIC MAP, WAILUKU, 1993, AND PAIA, 1983

FIGURE 2.2

INSTALLATION LOCATION MAP
292nd Combat Communications Squadron
Kahului Air National Guard
Kahului, Maui, Hawaii

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JANUARY 1995

requirements for air traffic control and communications facilities. The normal population of the Kahului ANGS is 23 personnel. The population increases to approximately 100 during weekend training exercises.

2.3 SIGNIFICANT STATION FACILITIES AND INFORMATION

The Station consists of Building 501 (communications electronics training facility), Building 502 (auto maintenance and communications equipment maintenance), Building 503 (a mobility warehouse), Building 551 (a fuel island and dispenser equipment), and two storage sheds, one for hazardous waste storage and one for flammable materials storage (see Figure 2.3). The Station is completely fenced, with controlled access.

Domestic water to the Station is provided by the County of Maui Department of Water Supply's 8-inch water main along Koeheke Street. According to County personnel, much of the water for domestic use in the Kahului area is imported from West Maui via an extensive water distribution system.

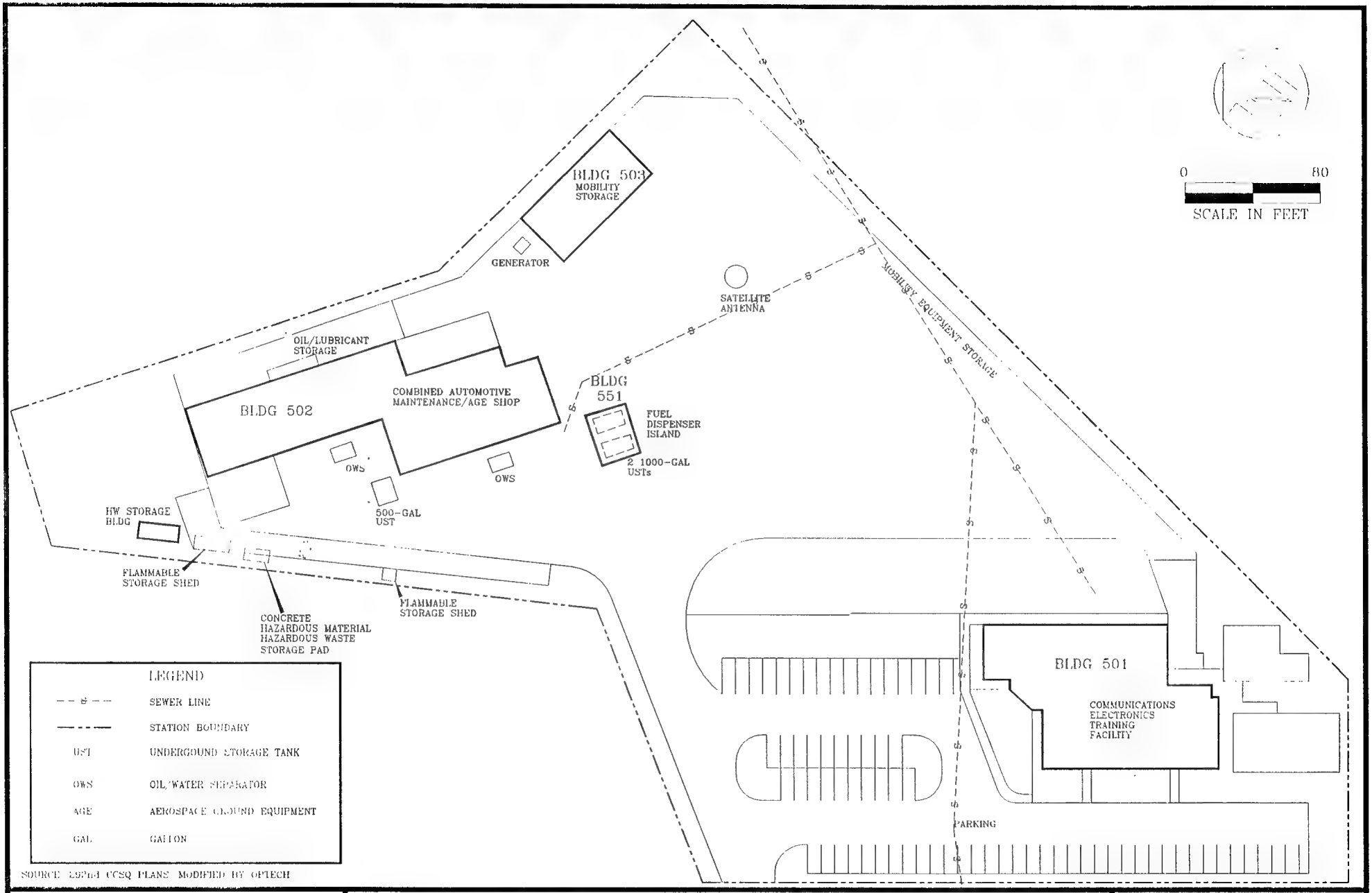
All sewage is conveyed off the Station by the Kahului Airport sewage treatment system. Buildings on the Station connect to an 8-inch sewer main which connects to the Kahului Airport system (see Figure 2.3).

In support of Station operational mission requirements, three underground storage tanks (USTs) are located on Kahului ANGS. All tanks were installed when the Station was constructed in 1983. Table 2.1 is an inventory listing of the USTs on the Station.

Table 2.1
Underground Storage Tank Inventory
292nd CBCS, Kahului Air National Guard Station
Maui County, Hawaii

Tank No.	Bldg. No.	Capacity (gallons)	Product	Construction	Year Installed	Current Status
001	502	500	Used oil	Fiberglass	1983	Active
002	502	1,000	MOGAS	Fiberglass	1983	Active
003	502	1,000	Diesel fuel	Fiberglass	1983	Active

MOGAS - motor gasoline No. – Number



SOURCE: 292nd CCSQ PLANS MODIFIED BY OPTECH

FIGURE 2.3

KAHULUI,KAHULUI

KAHULUI AIR NATIONAL GUARD STATION SITE PLAN

292nd Combat Communications Squadron
Kahului Air National Guard Station
Hawaii Air National Guard
Kahului, Maui, Hawaii

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JANUARY 1995

Precision leak testing was conducted by Tracer Resesarch Corporation on all three USTs for the years 1991, 1992 and 1993; all tanks and their associated piping successfully passed the leak detection testing.

SECTION 3.0 ENVIRONMENTAL SETTING

3.1 METEOROLOGY

3.1.1 Climatic Features

Among the 50 states, Hawaii is the only state surrounded by the ocean and the only one within the tropics. Both of these facts contribute significantly to its climate. The populated islands of the state are comprised of the easternmost members of the Hawaiian Island Chain. All of the islands are bordered by fringing coral reefs, and all have coasts that consist in part of sea cliffs, some of which are 300 to 3,000 feet in height.

The mountains, especially those of great height on Hawaii and Maui, strongly modify the marine effect and result in conditions that are semi-continental in some localities. The result is climatic conditions of great diversity. The most prominent feature of the circulation of air across the tropical Pacific is the tradewind flow in a general northeast-to-southwest direction.

In general, the Hawaiian climate is characterized by a two-season year, by mild and fairly uniform temperature conditions everywhere but at high altitudes, by strikingly marked geographic differences in rainfall, by generally humid conditions and high cloudiness except on the driest coasts and at high elevations, and by a general dominance of tradewind flow, especially at elevations below a few thousand feet. Except on high mountains, the general regime in Hawaii is one of high humidities, as compared with conditions in most other states.

3.1.1.1 Winds

The dominance of the tradewinds and the influence of terrain give special character to the climate of the islands. Tradewinds provide a system of natural ventilation much of the time throughout most of the State and bring to the land, at least in the lower lying regions, the mildly warm temperatures that are characteristic of air that has moved great distances across the tropical seas.

The wind conditions in Hawaii are exceedingly complex. Though the tradewinds are fairly constant in speed and though they blow a high percentage of the time across the adjacent sea and onto the bordering lands, the relatively uniform tradewind flow is distorted and disrupted by the

mountains, hills, and valleyways. In addition, there are local wind regimes along many of the coasts and on the mountain slopes.

Over the ocean around Hawaii, average windspeeds are highest during the summer tradewind period. During the summer months (May through October), the ocean winds exceed 12 miles an hour 50 percent of the time; 80 to 95 percent of the time these winds are from the northeast quadrant. During the winter (from November through April), when tradewinds are not quite as prevalent, windspeeds are in excess of 12 miles per hour about 40 percent of the time. When the tradewinds are moderate or strong--generally in excess of 14 miles per hour--they dominate the flow of air across wide reaches of the lowlands.

3.1.1.2 Humidity and Cloudiness

Because of the diversity of valleys, hills, and mountains, the moisture distribution within the air that moves across Hawaii is far from uniform. Under tradewind conditions, there is very often a pronounced moisture discontinuity at heights of between 4,000 and 8,000 feet above sea level. In general, windward areas tend to be cloudier during the summer, when tradewind clouds are more prevalent, while leeward areas, which are less affected by tradewind cloudiness, tend to be cloudier during the winter, when general storms and frontal passages are more frequent. (Blumenstock and Price, 1974)

3.1.1.3 Precipitation

Among Hawaii's outstanding climatic features are the remarkable differences in rainfall over short distances. The principal cause of this remarkable variability is the orographic, or mountain-caused, rain that forms within the moist air from trade winds as it ascends and traverses the steep and high terrain of the islands. The resulting rainfall distribution, in the mean, closely resembles the topographic contours. The amount is greatest over windward slopes and crests and is least toward the leeward lowlands.

The northeastern sides of the mountains are usually wettest because of the prevailing wind. Maximum precipitation occurs between altitudes of 2,000 and 6,000 feet, depending upon the form and height of each island. Above 6,000 feet the precipitation decreases, making high peaks semiarid. As the winds descend the lee slopes, they become warmer, drying winds, causing arid and semiarid climates on the leeward sides of the islands. The annual rainfall ranges from 10 inches or less on the lee coasts to about 450 inches on the wettest belts.

Rainfall is the principal source of recharge. However, the distribution of the rainfall is not the same in different island locales, and depends largely on the rainfall quantity and variability, and the absorption ability of the land surface. Rainfall varies widely over Maui from 400 inches per year at the crest of West Maui to 15 inches per year over part of the Isthmus, which is just six miles apart. The annual rainfall in the Kahului area is 10 to 40 inches. Most of the rain falls between November and April; there is very little rain during the summer. Of the approximately 685 million gallons per day of rainfall in the drainage basin which includes the Kahului ANGS, approximately 31 percent is lost to evapotranspiration, 47 percent is runoff, and only 21 percent is groundwater recharge. (Takasaki, 1978)

3.1.1.4 Temperatures

There are essentially two seasons in Hawaii, summer and winter. During the summer months, temperatures range from 70°F to 88°F and the weather is warm and dry. Northeasterly tradewinds are also present most of the time. During the winter season, the weather is cooler, and temperatures range from 60°F to 83°F. Elevation also affects the temperature. An increase of every 1,000 feet realizes a decrease in temperature of 4°F. Daytime temperatures are commonly in the 70s and 80s, and nighttime temperatures in the 60s to 70s. The maximum temperature rarely exceeds 90°F, and the minimum hovers around 50°F.

3.2 PHYSIOGRAPHIC SETTING

In the area of the Kahului ANGS, physiography is the result of the coalesence of the East Maui and West Maui volcanoes, which were separate islands during one period of Maui's development. During periods of volcano dormancy, deep canyons were cut, and the valleys were deeply filled with alluvium. Later volcanic eruptions filled the island canyons, and sand dunes formed on the Isthmus during periods of island emergence.

3.2.1 Topography and Drainage

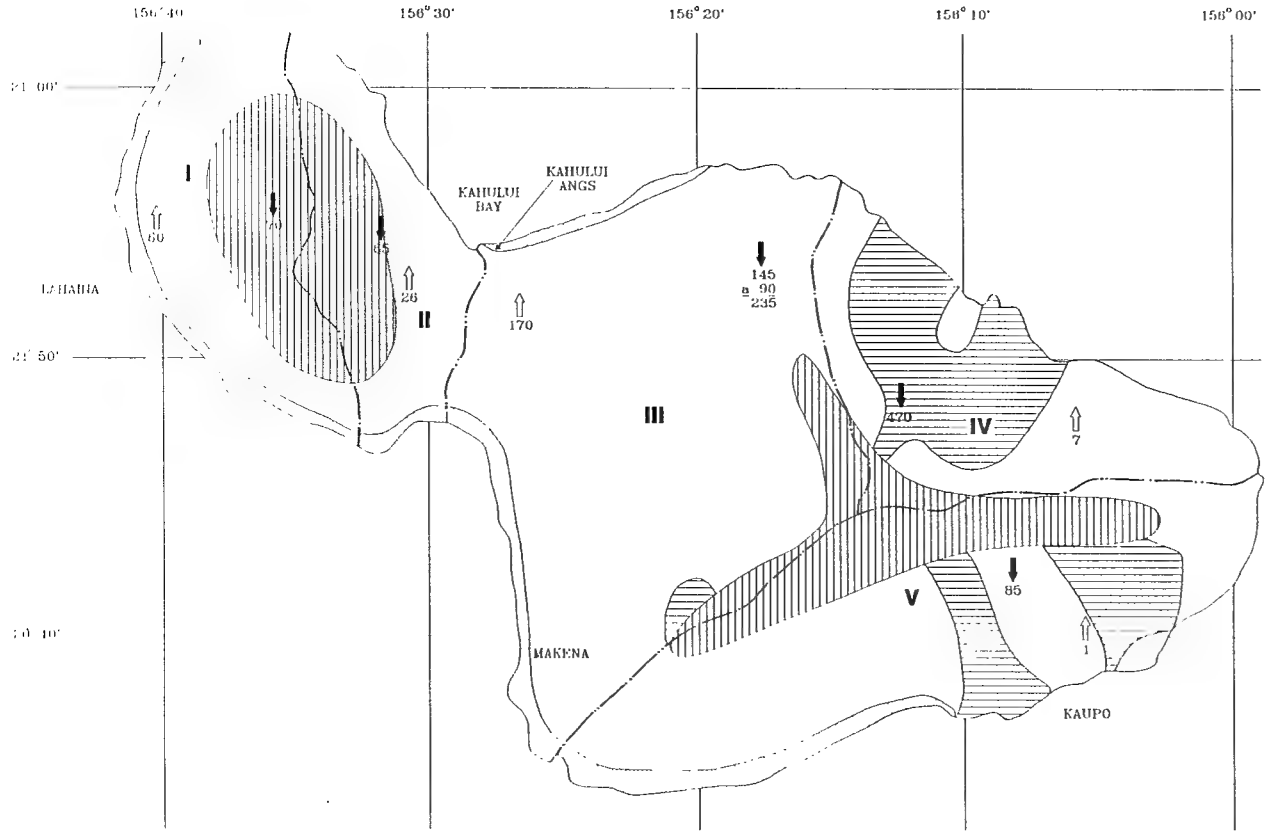
Kahului ANGS is located east of Kahului Bay on the northern coast of the Isthmus, the narrowest part of the island, which divides the island into the larger eastern section and the smaller western section. The Station is located on the western edge of Kahului Airport, Kahului, Maui County, on land administered by the Department of Transportation, Airports Division (DOTA). The Station is located approximately 20 feet above mean sea level (MSL). The area

topography slopes gently toward the Pacific Ocean, approximately 3,000 feet north of the Station.

Drainage in the Kahului area is a result of its location on the Isthmus, which is discussed further in Section 3.3.2. The area is situated at the juncture of two major drainage basins, which are the result of topography. The major drainage basin to the east resulted from the East Maui volcano (Mt. Haleakala) topographic features; drainage is channeled from the volcano summit westward toward the Isthmus. The western drainage basin resulted from the topographic features formed from the West Maui volcano (Puu Kukui), where the drainage is channeled eastward toward the Isthmus. Most streams in the islands are very flashy, and the greatest number are ephemeral. The permeability of the younger volcanoes is so great that no runoff occurs, and no well-defined stream channels exist even though the rainfall may exceed 200 inches per year. In the ancient West Maui Mountains, with their deep foreboding canyons, silvery streams of water find their way through a deep gorge into the sea, while on the great expanse of Mt. Haleakala on East Maui, water is visible in very few places, and those are near the coast. The surface of Haleakala is covered with lava flows still sufficiently young to be very porous. (Stearns, 1966)

The larger islands were subdivided into hydrographic areas by the Hawaii Water Authority in 1959. As shown in Figure 3.1, the boundaries of the areas are based on topography and generally outline the major surface drainage basins. (Takasaki, 1978)

Surface drainage on Kahului ANGS is effected by several swales. One swale, bisecting the Station from west to east across the asphalt parking area, empties into a low point along the eastern boundary of the Station. A smaller swale channels runoff along the northwest boundary of the Station to a low point at the northern boundary. Rainfall is quickly absorbed by the highly permeable soil, and there is no runoff to any surface water source. Any sheetflow collects in the grassy, low points at these northern and eastern corners of the Station and is prevented from migrating off the Station by a series of berms and curbs located several feet from the Station boundary fenceline. No storm sewers are located on the installation. Direction of runoff and surface water flow at Kahului ANGS is shown in Figure 3.2.



GROUNDWATER RECHARGE, MILLION GALLONS PER DAY

GROUNDWATER DRAFT, MILLION GALLONS PER DAY

a IRRIGATION–WATER RETURN, MILLION GALLONS PER DAY

II HYDROGRAPHIC AREA REPRESENTING MAJOR DRAINAGE BASIN

GROUNDWATER IMPOUNDED BY DIKES OR OTHER STRUCTURES

GROUNDWATER PERCHED ON SOIL, ASH OR THICK LAVA FLOWS ABOVE BASAL GROUNDWATER

BASAL GROUNDWATER FLOATING ON SALINE GROUNDWATER

BRACKISH BASAL GROUNDWATER

0 4 8
SCALE IN MILES

SOURCE MODIFIED FROM TAKASAKI 1978

FIGURE 3.1

R KAHULUI REGION

MAJOR DRAINAGE BASINS AND GROUNDWATER RESERVOIRS, ISLAND OF MAUI

292nd Combat Communications Squadron
Hawaii Air National Guard
Kahului, Maui, Hawaii

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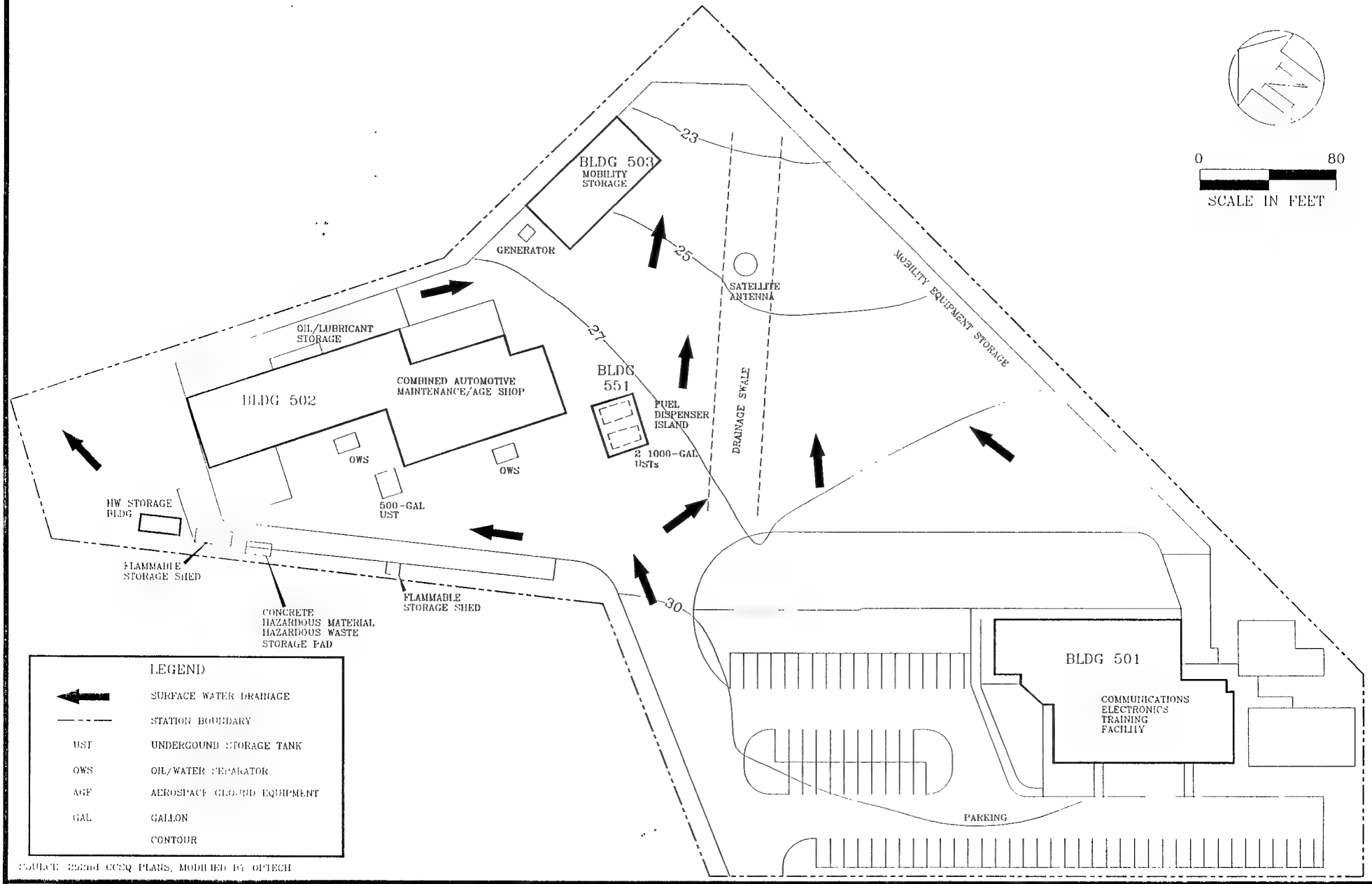

SOURCE: 292nd CCSQ PLANS, MODIFIED BY OPTECH

FIGURE 3.2

KAHULUI\KAHULUI

SURFACE DRAINAGE AT KAHULUI ANGS
292nd Combat Communications Squadron
Kahului Air National Guard Station
Hawaii Air National Guard
Kahului, Maui, Hawaii

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3.3 GEOLOGY

3.3.1 Regional Geology

The Earth's solid surface is divided into a dozen or so more or less rigid plates, 35 to 70 miles thick, which move laterally relative to each other over a zone of low rigidity in the upper part of the Earth's mantle. These plates have several types of boundaries, one being spreading boundaries in which adjacent plates are moving away from each other. These spreading boundaries lie mostly along the great series of ridges which girdle the Earth, largely on the ocean floors, and seismic activity along such ridges contributes to the source of new crustal material.

Hawaii is located within the Pacific Plate, and researchers agree that Hawaii is underlain by what is called a mantle plume. Mantle plumes are relatively narrow columns of hot mantle that rise from deep within the mantle. These plumes are found within plates and at divergent boundaries between plates. It has been recognized, on the basis of the degree of weathering and erosion, that the Hawaiian volcanoes decrease progressively in age from the northwest to the southeast, and it is believed that this is the result of the northwestward movement of the Pacific plate across a hot, magma-generating spot in the mantle, magma rising through the plate to form a volcano. The center of the plume underlying Hawaii is located close to Mauna Loa and Kilauea on the island of Hawaii. Radioactive dating of the lavas of Hawaiian volcanoes has confirmed the general southeastward decrease in age.

The Hawaiian Islands are a chain of shield-shaped basaltic domes built over a fissure 1,600 miles long in the ocean floor. The feature has existed since at least early Tertiary and probably longer. The lava now rises along tension cracks bounding blocks strung out linearly from southeast to northwest.

The larger, high volcanic islands (including the island of Maui) probably were built above sea level in Pliocene time (see Geologic Time Scale in the Glossary). Periods of eruptions resulted in island building, and the following periods of volcano dormancy and erosion resulted in the formation of deep canyons and high cliffs, with soils 5 to 100 feet thick forming in some areas. A period of great submergence followed the long erosion period, and then a new epoch of volcanism began, with secondary outbreaks continuing into the Holocene (or Recent) Epoch.

Each of the islands consists of one to five volcanic domes, the bulk of which is composed of thousands of basaltic lava flows. The lavas issued in repeated outpourings from narrow zones of fissures associated with each volcano, first below sea level, then above it, to form huge mountain masses. The basaltic lavas that were extruded above sea level are generally thin-bedded, highly clinkery, and highly permeable. All of the islands have sunk, to some extent, to adjust isostatically for their great weight on the earth's crust. Consequently, the highly permeable lava flows, which were originally extruded above sea level, now extend some distance below it. This rock assemblage of highly permeable basaltic lava flows makes up the principal reservoirs for groundwater in the Hawaiian islands.

Fissure eruptions characterize Hawaiian volcanoes. Seismic records indicate that the magma starts rising from the mantle about 35 miles below the surface and forms a reservoir within the crust at a depth of several miles. From there it finds its way to the surface through narrow dikes (areas of igneous intrusion). The usual eruption is preceded by a local earthquake as the ground opens to allow the exit of the magma. The fissures are a few inches to a few feet wide, and, during the rapid dome-building epoch, are limited to definite rift zones. The widest single dike known in Hawaii is 40 feet across; the average width is about 2 feet. Eruptions often begin with a lava fountain which is caused by frothing at the top of the lava column when pressure on the enclosed gases is released. Rivers of pahoehoe pour from the fissure, but as it flows down the mountainside, the lava usually changes to Aa. Recorded eruptions have lasted from a few hours to 18 months, and the flows have ranged in length from a few feet to 35 miles.

Hawaiian eruptions are self-extinguishing because eruption of lava to the surface is far more rapid than its replenishment from the source far below. Exposed parts of the Hawaiian volcanoes contain by volume less than one-half of 1 percent of explosive debris, thus indicating the dominance of lava outpourings. The flows range from a few inches to 900 feet in thickness, but most are from 10 to 30 feet. The main bulk of the domes consists of lava beds dipping 3° to 10° away from their source and rarely separated even by thin soil beds. Thin soils between flows in some volcanoes show that the time interval between eruptions lengthened toward the close of the dome-building epoch. Many of the soil beds are decomposed vitric tuff which, during the early phase of eruption, generally is deposited in small quantities by lava fountains near the vents.

Landscape features of volcanic origin may be either positive forms, the result of accumulation of volcanic materials, or negative forms, the result of lack of accumulation or of collapse. Both features are found in the State of Hawaii. Fissure eruptions which occur repeatedly along the

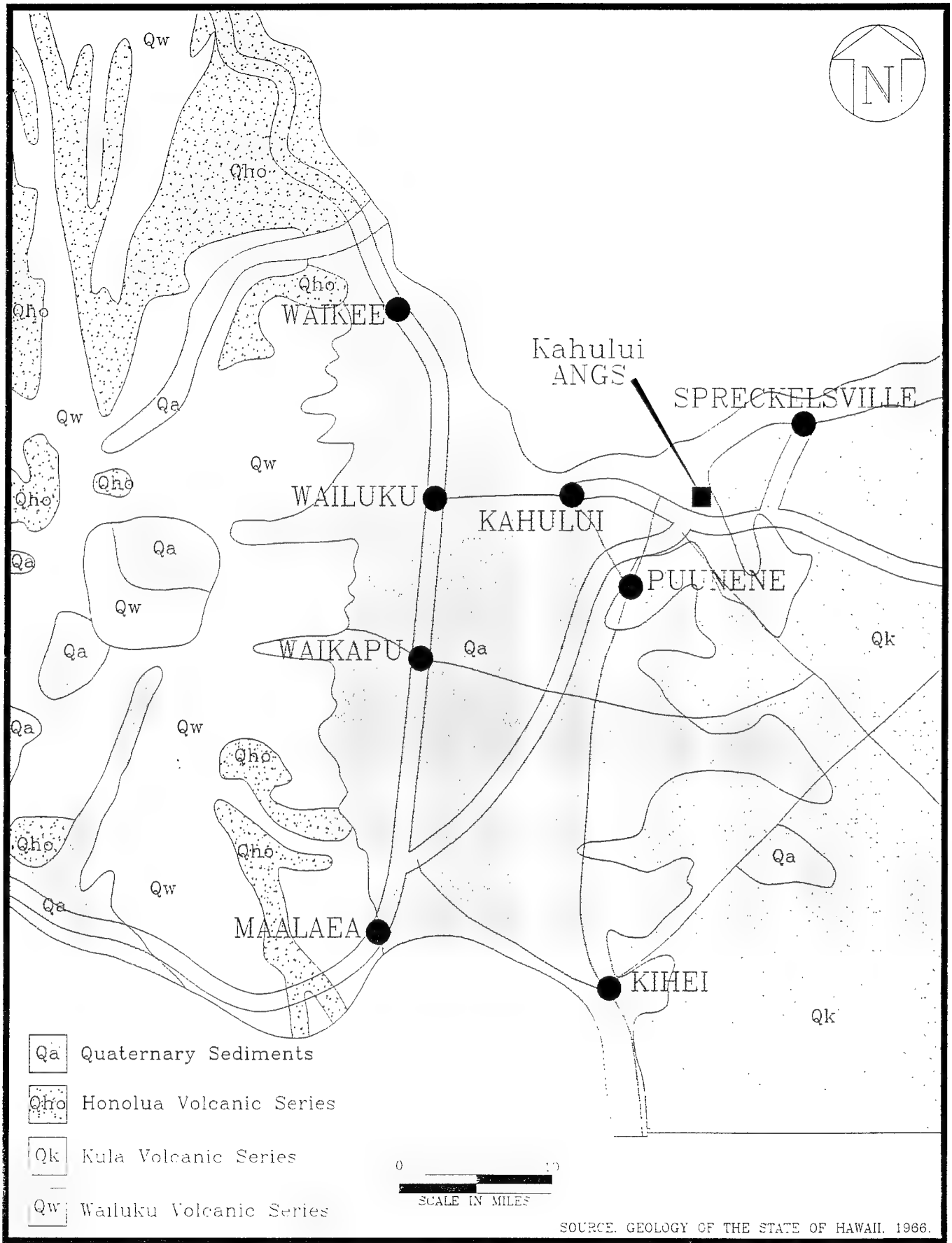
same zone of fissures result in a broadly rounded dome-shaped hill or mountain known as a shield volcano. Shield volcanoes consist almost wholly of innumerable superimposed thin lava flows. Small bowl-shaped depressions formed by explosion are known as craters, and most of them are found on the flanks of volcanic cones. A larger depression at the summit of volcanic cones are formed by collapse of the summit as the support beneath it is removed by the rapid withdrawal of magma. A depression of this sort is called a caldera.

Phreatic and phreatomagmatic explosions have occurred sparingly in the Hawaiian Islands. Such violent explosions may throw dust and ash high into the stratosphere, where it may drift for thousands of miles (ash from eruptions of Iceland has fallen in the streets of Moscow). Most of the solid fragments in the cloud settle out within a few days, and nearly all within a few weeks, but some finely divided material may remain suspended in the stratosphere for more than a year. (McGraw-Hill Encyclopedia of the Geological Sciences, 1978; and The Encyclopedia of Structural Geology and Plate Tectonics, 1987)

3.3.2 Local Geology

Maui is composed of two volcanic mountains: East Maui, or Haleakala Volcano, is 10,025 feet high and 33 miles across; and the West Maui Mountains, which include Puu Kukui Volcano, at 5,788 feet high and 18 miles across. The West Maui Mountains are distinguished for the Needle, a rock pinnacle in the spectacular Iao Valley. The presence of soils 20 feet or more thick indicates that Puu Kukui probably became extinct in the Pliocene or earliest Pleistocene Epoch. The West Maui Mountains are incised by deep amphitheater-headed valleys and on the east are overlapped by lava flows from Haleakala which have built a flat saddle known as the Isthmus. Haleakala has erupted every few hundred years, the most recent time about 1790.

As mentioned previously, Kahului ANGS is located on the Isthmus of Maui. The Isthmus is underlain by sedimentary rocks of the late Pleistocene, formed when the island passed through a series of submergences and emergences. The sedimentary rocks include alluvium, beach or dune sands (partly calcified), and mudflows or terrace deposits (see Figure 3.3). The extensive lithified dunes in the Isthmus area of Maui were formed by sands which were blown inland when the sea stood about 60 feet lower during the Pleistocene. A lithologic description of the geologic units underlying Maui is presented in Table 3.1.



SOURCE: GEOLOGY OF THE STATE OF HAWAII, 1966.

FIGURE 3.3

R KAHALUI 3QUMAP

GEOLOGIC MAP
292nd Combat Communications Squadron
Hawaii Air National Guard
Kahului, Maui, Hawaii

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JANUARY 1995

Table 3.1
Stratigraphic Rock Units on the Island of Maui

Age	Major Rock Units	
	East Maui	West Maui
Historic volcanic rocks	Volcanics erupted in 1790(?) near Makena.[1]	
Recent sediments	Unconsolidated deposits	Unconsolidated deposits
Pleistocene sediments	Calcareous dunes Consolidated earthy deposits Kaupo mudflow	Calcareous dunes Consolidated earthy deposits
Pleistocene and Recent volcanic rocks	Hana volcanic series (includes Kipahulu member in Kipahulu Valley)	Lahaina volcanic series
GREAT EROSIONAL UNCONFORMITY		
Pliocene and Pleistocene(?) volcanic rocks	Kula volcanic series	Honolua volcanic series
	Honomanu volcanic series	Wailuku volcanic series

[1] Formerly thought to be 1750(?)

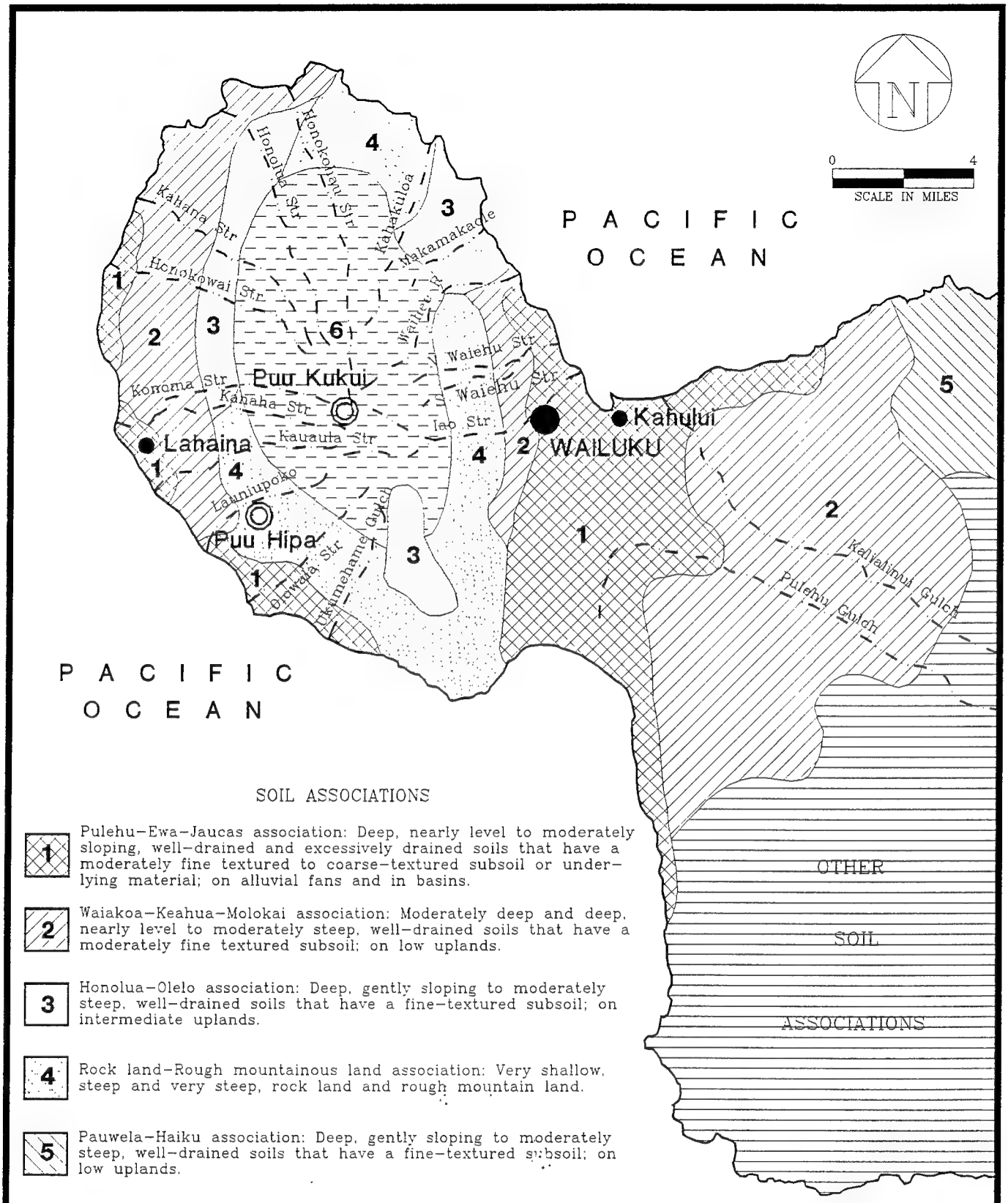
Source: Stearns, H. T., Geology of the State of Hawaii, 1966

3.3.3 Soils

The soils found in the area of Kahalui ANGS are of the Pulehu-Ewa-Jaucas association (see Figure 3.4). These soils are deep, nearly level to moderately sloping, well-drained and excessively drained soils that have a moderately fine-textured to coarse-textured subsoil or underlying material; the soils are found on alluvial fans and in basins.

The Jaucas Series consists of excessively drained, calcareous soils that occur as narrow strips on coastal plains, adjacent to the ocean. They developed in wind- and water-deposited sand from coral and seashells. Elevations range from sea level to 100 feet.

The soils at Kahului ANGS are classified as Jaucas sand, saline, 0 to 12 percent slopes (JcC). Permeability of this pale brown sandy soil ranges from 6.3 to 20 inches per hour, and the soil has a low shrink/swell potential. This soil occurs near the ocean in areas where the water table is near the surface and salts have accumulated, and any agricultural uses require heavy applications of irrigation water to prevent accumulation of salt in the soil. The soil is somewhat



SOURCE: U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, 1971.

FIGURE 3.4 KAHULUI MAP/SOIL	SOILS MAP FOR MAUI ISLAND 292nd Combat Communications Squadron Kahului Air National Guard Kahului, Maui, Hawaii	OPTECH OPERATIONAL TECHNOLOGIES CORPORATION JANUARY 1995

poorly drained in depressions but excessively drained on knolls. In the depressions, there is normally a layer of silty alluvial material flocculated by the high concentration of soluble salts. The water table is normally within a depth of 30 inches. This soil is used for pasture, wildlife habitat, and urban development. Vegetation on the salty soil in the depressions consists of salt-tolerant plants. (U. S. Department of Agriculture, Soil Conservation Service)

3.4 HYDROLOGY

3.4.1 Groundwater

Groundwater is Hawaii's most valuable mineral resource. Over 90 percent of the State's drinking water comes from underground sources. It takes approximately one ton of water to produce one pound of sugar, and the islands produce more than one million tons of sugar a year. Seawater is the biggest pollutant of freshwater, and many of the islands' groundwater problems are associated with the encroachment of saline water induced by development. As a result of development, the quality of the groundwater has deteriorated at some places, but water of less than potable quality can be tolerated in uses such as cooling and irrigation of sugarcane.

Most fresh groundwater is stored near and below sea level to depths ranging to 1,000 feet or more below sea level. The principal fresh groundwater reservoirs consist of thin-bedded basaltic lava flows. These reservoirs contain interconnected water bodies that are impounded by dikes in the interior of the islands or are in dynamic equilibrium with the underlying saline groundwater in the outer rims of the islands. Groundwater in these settings is referred to, respectively, as dike-impounded water and basal water. Water levels in wells rise and fall in response not only to general pumping and to rainfall variations, but also to changes in barometric pressure, the tides, and to earthquakes. (Stearns, 1966; and Takasaki, 1978)

One factor influencing island groundwater supplies is the difference in the weight of fresh groundwater and ocean water. The lighter fresh groundwater causes the fresh groundwater to float on salt groundwater. The basal-groundwater lens is maintained by recharge, which, if reduced, leads to thinning of the lens and subsequent encroachment of seawater. Groundwater in the Kahului area is an example of this principle; here fresh basal groundwater floats on salt groundwater, and, at locations within a mile of the coast, as at Kahului ANGS, brackish basal groundwater is found. (Stearns, 1966)

According to test borings completed from 5 to 11 feet below land surface (BLS) at Kahului ANGS prior to building construction, no groundwater was encountered. According to records obtained from the Department of Land and Natural Resources, Commission on Water Resource Management, wells drilled in the north coastal area of Maui normally range in depth from approximately 50 feet to over 100 feet. According to the Department of Health, Safe Drinking Water Branch, there are no drinking water wells within a one-mile radius of the Kahului ANGS. Irrigation requirements account for the greatest water use in Hawaii. In the Kahului ANGS area, the closest well is an irrigation well approximately 1,000 feet southeast of the Station, and the nearest drinking water well is over four miles away. Table 3.2 presents information on the wells located within a one-mile radius of Kahului ANGS, and the location of these wells is shown on Figure 3.5.

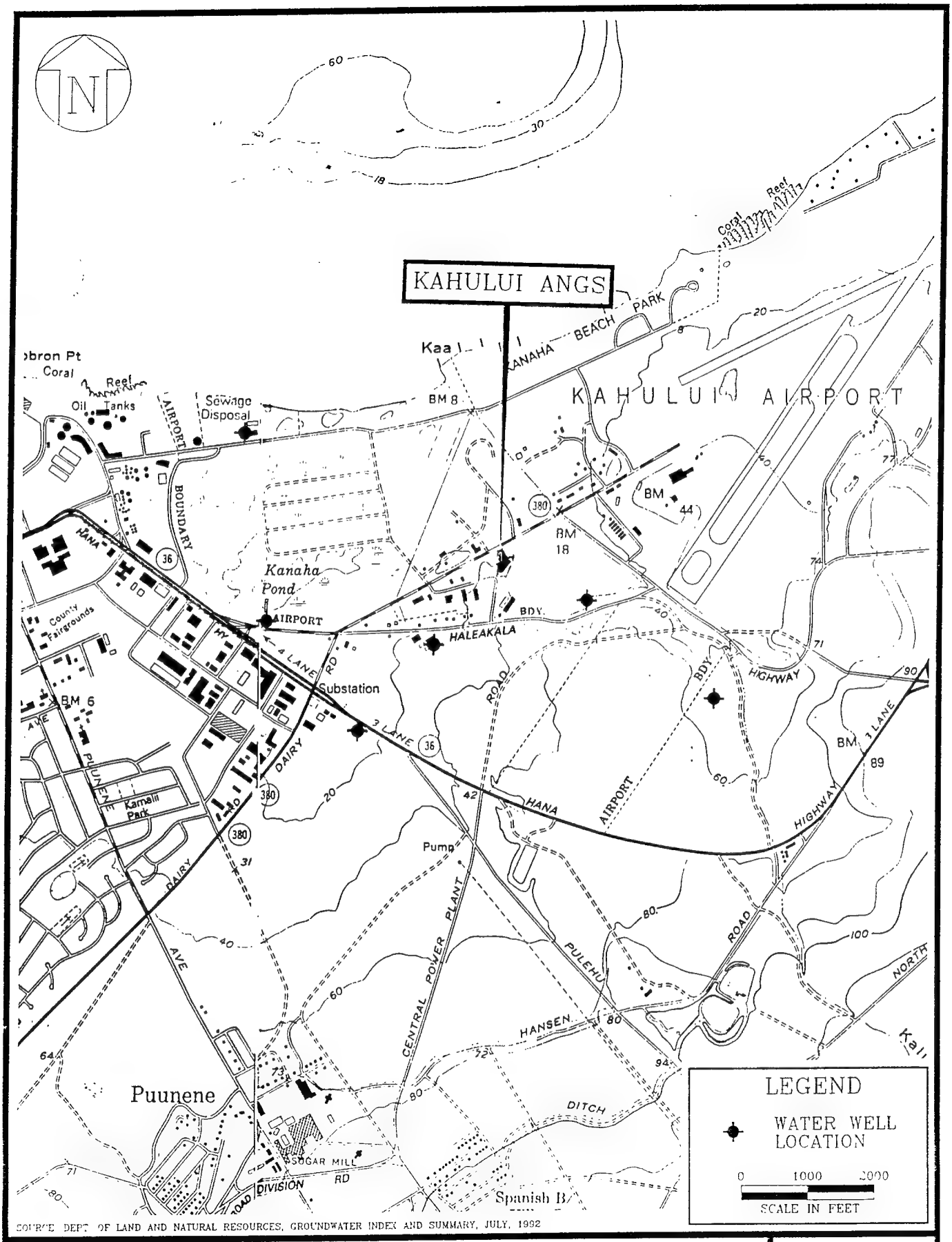
Table 3.2
Water Wells Within a One-Mile Radius of Kahului ANGS
Kahului, Maui

Well Number	Well Description	Total Depth (feet)	Static Water Level (feet AMSL)	Pumping Rate[1] (gpm)	Well Use/ Status
6-5326-01	H.C. & S. Co.	N/A	N/A	N/A	Sealed
6-5326-02	Valley Isle Produce	50	N/A	N/A	Irrigation
6-5327-10	Kanaha Pond	86	2.6	800	Unused
6-5327-07	Central Power Plant	N/A	N/A	N/A	Observation
6-5327-05	Haleakala Dairy	N/A	N/A	N/A	Unused
6-5427-08	Maui County	N/A	N/A	N/A	Disposal

Source: State of Hawaii. Department of Health, Safe Drinking Water Branch
and Department of Land and Natural Resources, Commission on Water Resource Management
Groundwater Index and Summary, July 1992.

[1] Maximum test pumping rate in gallons per minute.

AMSL – Above mean sea level.
N/A – Information not available.



SOURCE: DEPT. OF LAND AND NATURAL RESOURCES, GROUNDWATER INDEX AND SUMMARY, JULY, 1992

FIGURE 3.5

KAHALUI WELLS

WELLS IN AREA OF KAHULUI ANGS
292nd Combat Communications Squadron
Hawaii Air National Guard
Kahului, Maui, Hawaii

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JANUARY 1995

3.4.2 Surface Water

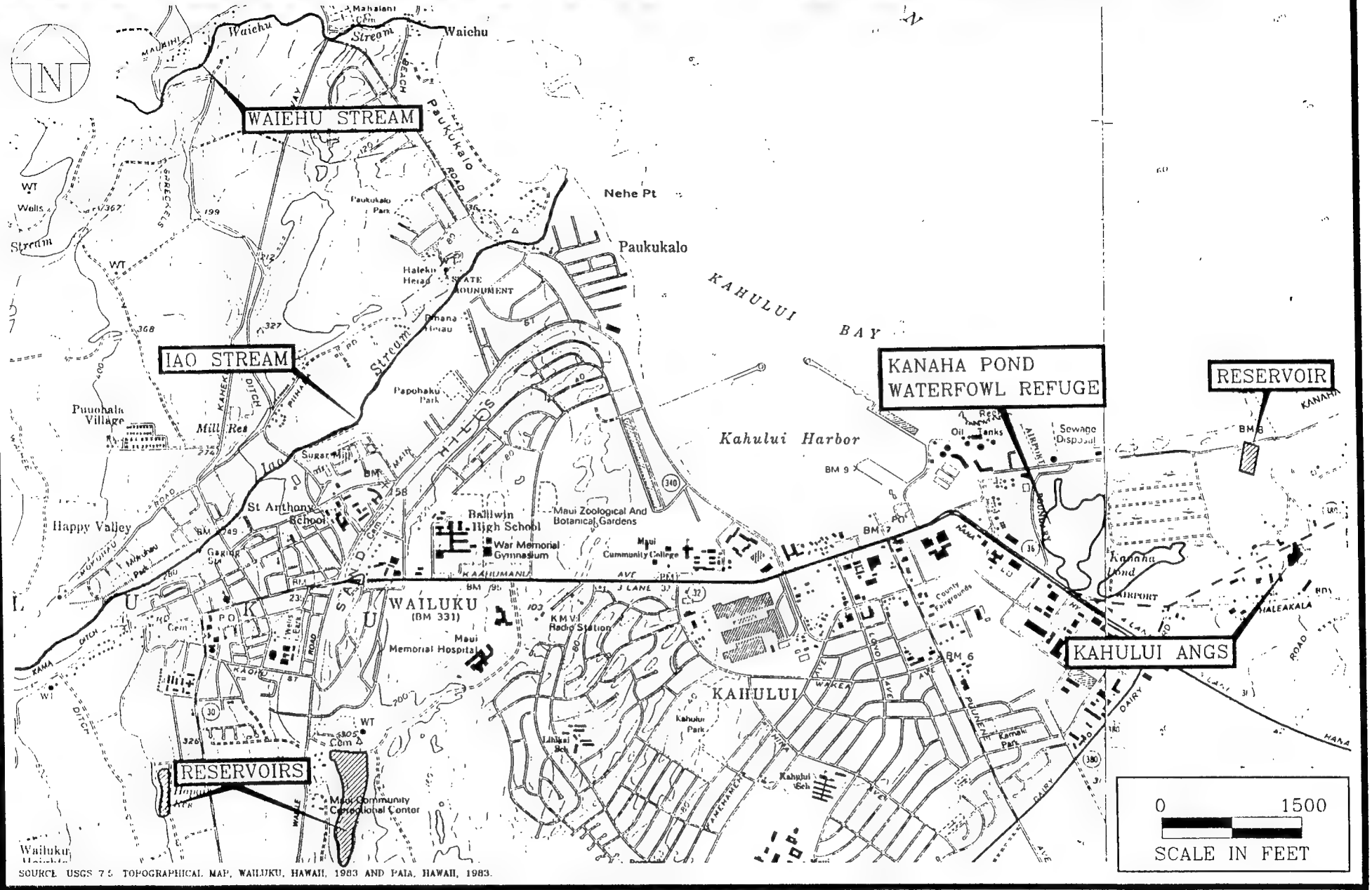
In Hawaii, groundwater resources offer better prospects for supplying water needs than surface water resources. Most of the surface supplies that are easy to develop have been fully utilized where needed, and conduits and reservoirs necessary to develop new or additional supplies would generally require large and perhaps prohibitive outlays of capital. (Takasaki, 1978)

The Isthmus area of Maui is a prime agricultural area for pineapple and sugar cane, and the area is dotted with numerous small circular ponds and reservoirs. From these reservoirs extend a vast network of narrow ribbons--the main irrigation ditches which bring to the thirsty Isthmus the flow of streams from the rainy windward northeast slopes. A number of these small, impounded reservoirs lie in the area surrounding the Kahului ANGS and are used for crop irrigation. Additionally, several perennial rivers and streams, which originate in the steep mountains of West Maui, empty into Kahului Bay and the Pacific Ocean. (National Wetlands Inventory, U. S. Department of the Interior, Fish and Wildlife Service)

3.5 CRITICAL HABITATS/ENDANGERED OR THREATENED SPECIES

Approximately 2,000 feet from Kahului ANGS lies an important wetlands site and waterfowl refuge, Kanaha Pond. The spring-fed freshwater pond, which lies approximately 2,000 feet inland from the Pacific Ocean, currently contains approximately 75 acres of open water. Originally constructed over 200 years ago by the King of Hawaii as a fish pond, the pond was altered considerably and used by the U.S. Navy during World War II for storage of ammunition and other equipment. The Navy brought in fill material and built an extensive road system with numerous storage bunkers in the pond, and these former roads are clearly visible on the topographic map (see Figure 3.6). With the development of Kahului Airport, the site came under control of the State of Hawaii Department of Transportation. In 1952, the pond was granted status as a State wildlife refuge. The pond is currently managed by a cooperative agreement between the State Department of Land and Natural Resources and the Federal Aviation Administration. The pond was declared a Registered National Natural History Landmark in 1971.

Kanaha Pond provides important water bird habitat and supports several species of endangered waterbirds, in addition to migratory waterfowl and other non-waterbird avifauna and non-avian wildlife. Several endangered bird species are found at the site, as indicated below, and other



SOURCE: USGS 7.5 TOPOGRAPHICAL MAP, WAILUKU, HAWAII, 1983 AND PAIA, HAWAII, 1983.

FIGURE 3.6

KAHU\SURFACE

AREA SURFACE WATER LOCATIONS

292nd Combat Communications Squadron
Kahului Air National Guard
Kahului, Maui, Hawaii

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FEBRUARY 1995

birds observed at the site include numerous black-crowned night herons, cattle egrets and various species of ducks and geese. Unfortunately, this prime waterfowl habitat is not secure from the threats of encroaching urbanization and conflicting land use. Threats to the quality of this critical habitat result from increased human disturbance, commercial development, a nearby injection sewage plant, and potential pollution from neighboring tracts.

According to records of the U. S. Fish and Wildlife Service, Pacific Islands Ecoregion, the following endangered species may exist within an approximate 5-mile radius of the Kahului ANGS:

Species	**Remarks**
Mammal	
Hoary bat	Last sighted in area in 1992
Birds	
Hawaiian stilt or ae'o	Occurs at Kanaha Pond; last sighted in area in 1994
Hawaiian coot	Occurs at Kanaha pond; last sighted in area in 1994
Invertebrates	
Orange black megalagrion damselfly	Candidate for endangered species listing
Pacific megalagrion damselfly	Candidate for endangered species listing

According to surveys conducted by the State of Hawaii in 1963 and 1990, two species of native freshwater gobies, *Awaous stamineus* and *Sicyopterus stimpsoni*, occur in the Waiehu Stream and Iao Stream which empty into Kahului Bay. These waterways are shown in Figure 3.6.

Species which may be found in the marine environment along the north coast of Maui include the threatened green turtle *Chelonia mydas*, and endangered hawksbill turtles (*Eretmochelys imbricata*), Hawaiian monk seals (*Monachus schauinslandi*), and humpback whales (*Megaptera novaeangliae*). Because the Kahului ANGS is so far removed from the marine environment, no adverse effects to such species are anticipated as a result of activities conducted at the Station. (National Marine Fisheries)

SECTION 4.0 AOC EVALUATION

4.1 BACKGROUND WASTE GENERATION

A review of Station records, interviews with Station personnel, and completion of hazardous waste work forms by Station personnel resulted in the identification of specific operations at Kahului ANGS in which industrial chemicals are handled and hazardous wastes are generated. Eight present and former Station personnel were interviewed.

The major operation of the Station which has involved the generation and disposal of hazardous materials is the maintenance of vehicles. An average of 12 to 15 vehicles are maintained at the Station. Hazardous wastes generated at the facility include waste oils and fluids, solvents, diesel fuel, paint, and paint thinner. Other materials generated include used batteries and oil filters. Waste solvents, paints, and diesel fuel are temporarily stored in 55-gallon metal drums in a concrete-paved, bermed, waste storage area along the northwest side of the Station. The drums are stored on pallets, are clearly marked, and are equipped with plastic lids to prevent accumulation of rain water and subsequent rusting. These wastes are temporarily stored until picked up and removed from the Station by civilian contractors. Waste oil, formerly stored in the 500-gallon used oil UST, is now stored in drums until it is removed for recycling by civilian contractors. The used oil UST was drained in 1993 and is not currently in use. Used batteries generated at the Station are stored on pallets in the concrete bermed area until picked up for recycling by a civilian contractor, and the Station participates in a one-for-one battery exchange program with a private contractor.

All paints and flammables used at the Station are segregated from other hazardous materials and stored in a separate metal shed near the western fenceline. Any other hazardous materials are stored and secured in another building located nearby, also along the western fenceline.

Table 4.1 summarizes major Station operations which handle or generate hazardous wastes and hazardous materials, as well as information on estimated quantities, and past and present waste disposal practices. Any Station operations not included in Table 4.1 are considered to produce low quantities of HM/HW.

Table 4.1
Inventory of Hazardous Materials Used at Kahului ANGS
292nd CBCS, Kahului ANGS, Kahului, Maui

Shop	Possible Waste Materials	Quantities/ Disposed Gallons/year	Methods of Disposal	
			1980s	Present
Vehicle Maintenance	Paint Thinner	5	CIV	CIV
	Paint	5	CIV	CIV
	Hydraulic Oil	.5	CIV	CIV
	Transmission Fluid	6	CIV	CIV
	Motor Oil	150	CIV	CIV
	Bearing Grease	2	CIV	CIV
	Fuel & Oil Filters	200 ea.	COUNTY	COUNTY
	Brake Fluid	.5	CIV	CIV
	Diesel Fuel	20	CIV	CIV
Power Production	PD-680	20	CIV	N/A
	Engine Oil or Motor Oil	55	CIV	CIV
Battery Shop	Used Batteries (Wet Cell)	37 ea.	DRMO	CIV
	Batteries (Dry Cell)	550 ea.	COUNTY	COUNTY
	Battery Acid	18	NEUT SAN	N/A

CIV - Disposed of through Civilian Contractor.
NEUT SAN - Neutralized and disposed of through sanitary sewer.
COUNTY - Disposed of at a dumpster.
DRMO - Disposed of through the Defense Reutilization and Marketing Office.
N/A - Not applicable (no longer used).

As mentioned previously, the Station is located on land owned by the State Department of Transportation Airports Division. As a tenant, the Station is inspected annually by airport inspectors to ensure that Station personnel are following sound environmental practices. The Station has successfully passed each inspection.

The Station contains three USTs: two 1,000-gallon fiberglass tanks, one containing #2 diesel fuel and one containing unleaded gasoline, and one fiberglass 550-gallon used oil storage tank. The three USTs were leak tested in 1991, 1992 and 1993, and all tanks and their associated piping passed. All USTs were installed when the Station was constructed in 1982-83. Plans call for the replacement of the USTs by aboveground storage tanks.

In addition to the diesel UST, diesel fuel is also temporarily stored in 55-gallon drums for power generation during periodic runups of mission generators. These activities normally take place west of Building 503.

4.2 AOC DESCRIPTION, EVALUATION AND HAZARD ASSESSMENT

No formal areas of concern (AOCs) at Kahului ANGS have been identified for further investigation.

4.3 OTHER PERTINENT INFORMATION

4.3.1 On-Site Areas

An Environmental Compliance Assessment and Management Program (ECAMP) report on the 292nd CBCS, dated September 29, 1993, revealed several minor infractions, several of which involved waste containers and hazardous waste storage. The minor infractions were subsequently corrected. One deficiency cited in the report was the deteriorated oil/water separators (see photographs in Appendix B). Two oil/water separators are located on the Station and are attached to shop floor drains in Building 502. However, Station personnel no longer discharge to the oil/water separators, and current plans call for the separators to be removed and the drains permanently plugged.

4.3.2 Surrounding Properties

The Kahului ANGS is located on land administered by the State Department of Transportation Airports Division. In addition to tenants that offer airport support services, such as rental car agencies and tour operations, DOTA tenants include construction and trucking companies, small manufacturing operations, State agency baseyards and operations areas, storage facilities, and miscellaneous small businesses. Most of these tenants are engaged in activities which require the storage, use and disposal of hazardous materials. Immediately adjacent to the Kahului

ANGS on the northeast is the DOTA maintenance baseyard. Vehicle maintenance, painting, washing and fueling activities are conducted onsite, and four USTs are located on the property. Adjacent to the Station on the southeast is the baseyard for the State Department of Land and Natural Resources (DLNR). The DLNR facilities include a warehouse, greenhouse, storage building, maintenance shop, fueling station and parking facilities for department equipment. Across Kuleana Street, on the southwest side of the Kahului ANGS, is the Department of Transportation Highways Division baseyard. Activities conducted at this facility include vehicle maintenance, painting, fueling and washing. Four USTs are located onsite. Tenants located next to the Department of Transportation Highways Division baseyard facility include a scaffolding rental business and a junk yard (a copy of an aerial photograph showing the Kahului ANGS and the surrounding properties is provided in Appendix B).

Although several car rental agencies near the airport terminal appear on the State Leaking Underground Storage Tank Listing, none of the facilities in the immediate vicinity of the Station appear on this listing, nor are any of the adjacent facilities included on the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) listing or listing of RCRA violators. There are no NPL sites in Maui County.

SECTION 5.0 CONCLUSIONS

No AOCs will be further investigated.

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SECTION 6.0 RECOMMENDATIONS

No further IRP investigation is warranted since no formal AOCs have been identified.

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GLOSSARY OF TERMS

AA - A Hawaiian term for lava flows typified by a rough, jagged, clinkery surface.

ALLUVIAL - Pertaining to or composed of alluvium or deposited by a stream or running water.

ALLUVIUM - A general term for detrital deposits made by streams on river beds, flood plains, and alluvial fans. The term applies to stream deposits of recent time.

ANDESITE - A dark-colored, fine-grained extrusive rock.

ANNUAL PRECIPITATION - The total amount of rainfall and snowfall for the year.

AQUIFER - A body of rock that is sufficiently permeable to conduct groundwater and yield economically significant quantities of water to wells and springs.

ARTESIAN - A hydrologic condition whereby groundwater is confined, under pressure greater than atmospheric, by overlying, relatively impermeable strata.

ASH – Fine pyroclastic material (under 2.0-millimeter diameter).

BASALT - A dark-colored igneous rock, commonly extrusive, composed primarily of calcic plagioclase and pyroxene; the fine-grained equivalent of gabbro.

BASIN - (a) A depressed area with no surface outlet; (b) A drainage basin or river basin: (c) A low area in the Earth's crust, of tectonic origin, in which sediments have accumulated.

BAY - A wide, curving open indentation, recess, or inlet of a sea or lake into the land or between two capes or headlands, larger than a cove, and usually smaller than, but of the same general character as a gulf.

BED (stratigraphy) - The smallest form of a unit in the hierarchy of lithostratigraphic units. In a stratified sequence of rocks, it is distinguishable from layers above and below. A bed commonly ranges from a centimeter to a few meters.

BEDDING (stratigraphy) - The arrangement of sedimentary rock in beds or layers of varying thickness and character.

BEDROCK - A general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material.

BRECCIA – A coarse-grained clastic rock composed of angular broken rock fragments held together by a mineral cement or in a fine-grained matrix.

GLOSSARY OF TERMS (Continued)

CALCAREOUS - Containing calcium carbonate. When applied to a rock name, it implies that as much as 50% of the rock is calcium carbonate.

CALDERA - A large basin-shaped volcanic depression.

CINDER CONE – A conical hill formed by the accumulation of cinders and other pyroclasts, normally of basaltic or andesitic composition.

CLASTIC - Pertaining to a rock or sediment composed principally of fragments derived from pre-existing rocks or minerals and transported some distance from their places or origin.

CLAY (soil) - A rock or mineral particle in the soil having a diameter less than 0.002 mm (*2 microns).

CLAY (geol) - a rock or mineral fragment or a detrital particle of any composition smaller than a fine silt grain, having a diameter less than 1/256 mm (4 microns).

COARSE-TEXTURED (light textured) SOIL - Sand or loamy sand.

CONFINED AQUIFER - An aquifer bounded above and below by impermeable beds, or by beds of distinctly lower permeability than that of the aquifer itself.

CONGLOMERATE - A coarse-grained sedimentary rock, composed of rounded pebbles, cobbles, and boulders, set in a fine-grained matrix of sand or silt, and commonly cemented by calcium carbonate, iron oxide, silica, or hardened clay.

CONSOLIDATION - Any process whereby loosely aggregated, soft, or liquid earth materials become firm and coherent rock; specifically the solidification of a magma to form an igneous rock or the lithification of loose sediment to form a sedimentary rock.

CONTAMINANT - As defined by Section 101(f)(33) of Superfund Amendments and Reauthorization Act of 1986 (SARA) shall include, but is not limited to any element. substance compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly be ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation. physiological malfunctions (including malfunctions in reproduction), or physical deformation in such organisms of their offspring; except that the term "contaminant" shall not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under:

(a) any substance designated pursuant to Section 311(b)(2)(A) of the Federal Water Pollution Control Act,

(b) any element, compound, mixture, solution, or substance designated pursuant to Section 102 of this Act,

(c) any hazardous waste having the characteristics identified under or listed pursuant to Section 3001 of the Solid Waste Disposal Act (but not including any waste the regulation of which under the Solid Waste Disposal Act has been suspended by Act of Congress),

(d) any toxic pollutant listed under Section 307(a) of the Federal Water Pollution Control Act,

(e) any hazardous air pollutant listed under Section 112 of the Clean Air Act, and

(f) any imminently hazardous chemical substance or mixture with respect to which the administrator has taken action pursuant to Section 7 of the Toxic Substance Control Act;

and shall not include natural gas, liquified natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas).

CORAL REEF - A coral-algal or coral-dominated mound or ridge of in-place coral colonies and skeletal fragments, carbonate sand, and organically secreted calcium carbonate.

CRITICAL HABITAT - The specific areas within the geographical area occupied by the species on which are found those physical or biological features (1) essential to the conservation of the species, and (2) which may require special management consideration or protection.

DEPOSITS - Earth material of any type, either consolidated or unconsolidated, that has accumulated by some natural process or agent.

DIKE - A tabular body of igneous rock that cuts across the structure of adjacent rocks or cuts massive rocks.

DRAINAGE CLASS (natural) - Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

GLOSSARY OF TERMS (Continued)

Excessively drained - Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained - Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well-drained - Water is removed from the soil somewhat readily, but not rapidly. it is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well-drained soils are commonly medium textures. They are mainly free of mottling.

Moderately well drained - Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the soil, or periodically receive high rainfall or both.

Somewhat poorly drained - Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained - Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough periods during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very Poorly drained - Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

GLOSSARY OF TERMS (Continued)

DRAINAGEWAY - A channel of course along which water moves in draining an area.

DUST (volc) – A synonym of volcanic ash, especially the finer fractions of ash.

ENDANGERED SPECIES - Any species which is in danger of extinction throughout all or a significant portion of its range, other than a species of the Class Insecta determined by the secretary to constitute a pest whose protection would present an overwhelming and overriding risk to man.

EROSION - The general process or the group of processes whereby the materials of the earth's crust are loosened, dissolved, or worn away, and simultaneously moved from one place to another by natural agencies, but usually exclude mass wasting.

ERUPTION - The ejection of volcanic materials (lava, pyroclasts, and volcanic gases) onto the earth's surface, either from a central vent or from a fissure or group of fissures.

FAULT - A fracture or fracture zone along which there has been displacement of the sides relative to one another parallel to the fracture.

FELDSPAR - A group of abundant rock-forming minerals; the group is the most widespread of any mineral group and may constitute 60% of the earth's crust, occurring in all types of rock.

FINE-GRAINED - Said of a soil in which silt and/or clay predominate.

FINE-TEXTURED SOIL - Sandy clay, silty clay, and clay.

FLOOD PLAIN - That portion of a river valley, adjacent to the channel, which is built of sediments deposited during the present regimen of the stream and is covered with water when the river overflows its banks at flood stage.

FOLD - A curve or bed of a planar structure such as rock strata, bedding planes, foliation or cleavage.

FORMATION - A lithologically distinctive, mappable body of rock.

FRACTURE (structural geology) - A general term for any break in a rock, whether or not it causes displacement, due to mechanical failure be stress. Fracture includes crack, joints, and faults.

GABBRO - A group of dark-colored, basic intrusive igneous rocks composed principally of basic plagioclase; approximate intrusive equivalent of basalt.

GEOLOGIC TIME - See Figure GL.1.

GRABEN – An elongate, relatively depressed crustal unit or block that is bounded by faults on its long sides; it may also be known as a "rift valley."

GRAVEL - An unconsolidated, natural accumulation of rounded rock fragments resulting from erosion, consisting predominantly of particles larger than sand, such as boulders, cobbles, pebbles, granules or any combination of these fragments.

GROUNDWATER - Refers to the subsurface water that occurs beneath the water table in soils and geologic formations that are fully saturated.

GROUNDWATER DRAFT – Groundwater withdrawn from the subsurface.

HAZARDOUS MATERIAL - Any substance or mixture of substances having properties capable of producing adverse effects on the health and safety of the human being. Specific regulatory definitions also found in OSHA and DOT rules.

HAZARDOUS SUBSTANCE - CERCLA hazardous substances, pollutants, and contaminant as defined in CERCLA sections 101(14) and 101(33).

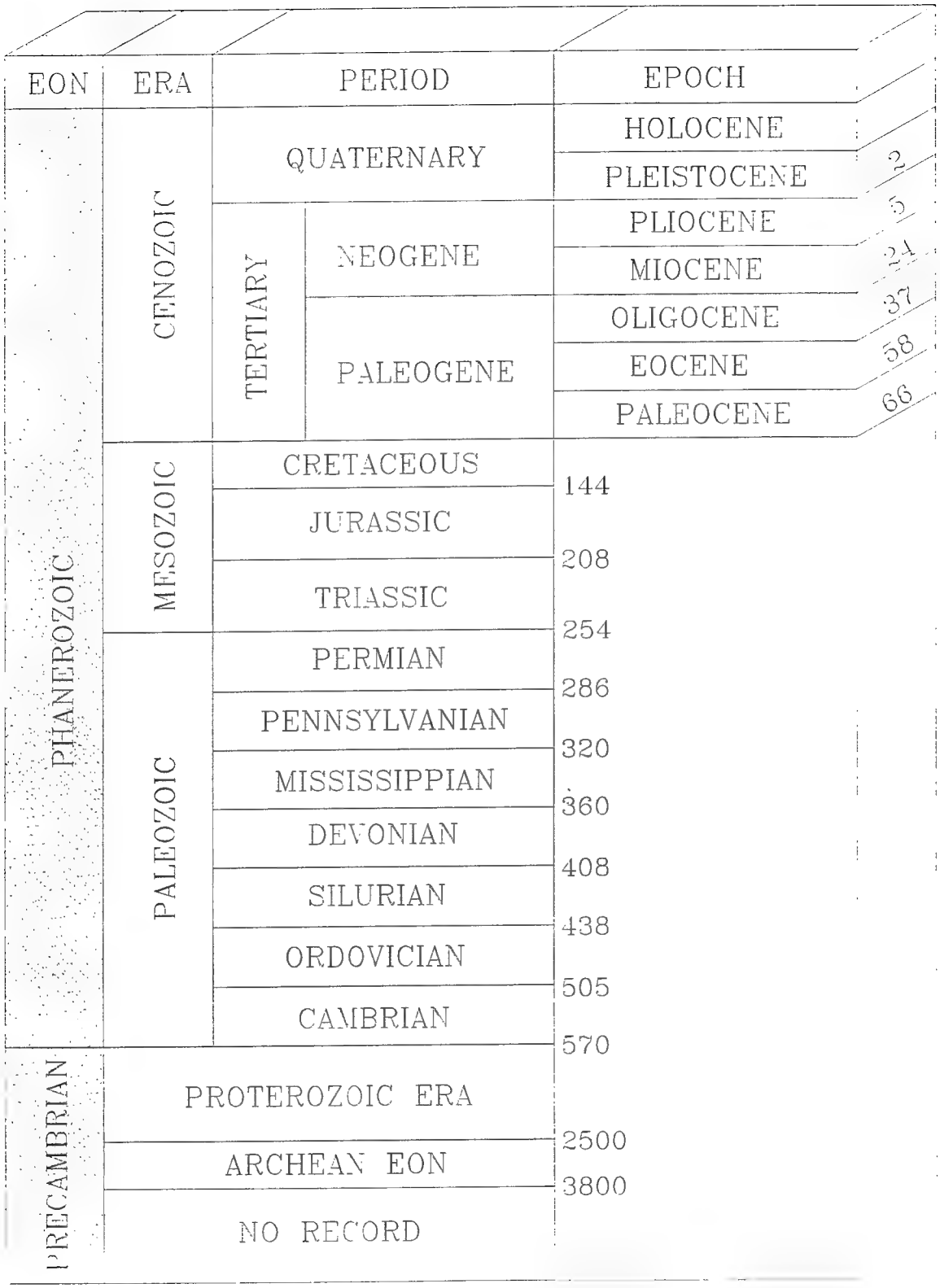
HAZARDOUS WASTE - A solid or liquid waste that, because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause, or significantly contribute to, an increase in mortality or an increase in serious or incapacitating reversible illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

HYDRAULIC CONDUCTIVITY – The capacity of a rock to transmit water.

IGNEOUS ROCKS - Rock or mineral that has solidified from molten or partially molten material; i.e., from magma.

INJECTION WELL - A well into which subsurface disposal of fluid or fluids occurs or is intended to occur by means of injection.

LAGOON – A shallow stretch of seawater, such as a sound, channel, bay, or saltwater lake, near or communicating with the sea and partly or completely separated from it by a low, narrow, elongate strip of such such as a reef, barrier island, sandbank, or spit, especially the sheet of water between an offshore coral reef and the mainland.



NOTE. NUMBERS ARE IN MILLIONS OF YEARS BEFORE THE PRESENT

FIGURE GL.1

REKAHA TIMESCAL

THE GEOLOGICAL TIME SCALE

292nd Combat Communications Squadron
Hawaii Air National Guard
Kahului, Maui, Hawaii

OPTECH
OPERATIONAL TECHNOLOGIES CORPORATION

JANUARY 1995

GLOSSARY OF TERMS (Continued)

LAVA - Fluid rock that issues from a volcano or fissure; also, the same material solidified by cooling.

LITHOLOGY - (a) The description of rocks. (b) The physical character of a rock.

LOWLAND - A general term for low-lying land or an extensive region of low land, especially near the coast and including the extended plains or country lying not far above tide level.

MAGMA - Naturally occurring molten rock material, generated within the earth and capable of intrusion and extrusion, from which igneous rocks have been derived through solidification and related processes.

MANTLE – The zone of Earth below the crust and above the core.

MARSH - A water-saturated, poorly drained area, intermittently or permanently water-covered, having aquatic and grasslike vegetation, essentially without the formation of peat.

METAMORPHIC ROCK - Any rock derived from pre-existing rocks by mineralogical, chemical, and/or structural changes in response to changes in temperature, pressure, shearing stress, and chemical environment, generally at depth in the earth's crust.

MIGRATION (Contaminant) - The movement of contaminants through pathways (groundwater, surface water, soil, and air).

OLIVINE - A common rock-forming mineral of basic, ultrabasic, and low-silica igneous rocks (gabbro, basalt, peridotite, dunite); it crystallizes early from a magma, weathers readily at the earth's surface, and metamorphoses to serpentine.

OUTCROP - That part of a geological formation or structure that appears at the surface of the earth; also, bedrock that is covered only by surficial deposits such as alluvium.

PAHOEHOE - A Hawaiian term for basaltic lava flows typified by a smooth, billowy, or ropy surface.

PERCHED GROUNDWATER - Unconfined groundwater separated from the underlying main body of groundwater by unsaturated rock.

PERMEABILITY - The capacity of a porous rock, sediment, or soil for transmitting a fluid without impairment by the structure of the medium; it is a measure of the relative ease of fluid flow under unequal pressure.

GLOSSARY OF TERMS (Continued)

PHENOCRYSTS - One of the relatively large and ordinarily conspicuous crystals of the earliest generation in a porphyritic igneous rock.

PHREATIC EXPLOSION – A volcanic eruption or explosion of steam, mud, or other material that is not incandescent.

PHREATOMAGMATIC EXPLOSION – A volcanic explosion that extrudes both magmatic gases and steam; it is caused by the contact of magma with groundwater or shallow surface water.

POND - A natural body of standing fresh water occupying a small surface depression, usually smaller than a lake and larger than a pool.

POROSITY - The ratio of the aggregate volume of interstices in a rock or soil to its total volume.

PORPHYRITIC - A textural term for those igneous rocks in which larger crystals (phenocrysts or insets) are set in a finer groundmass which may be crystalline or glassy, or both.

POTENTIOMETRIC SURFACE - An imaginary surface representing the total head of groundwater and defined by the level to which water will rise in a well. The water table is a particular potentiometric surface.

PYROCLAST – An individual particle ejected during a volcanic eruption.

RIFT ZONE - A system of crustal fractures and faults.

RIVER - A general term for a natural freshwater surface stream of considerable volume and a permanent or seasonal flow, moving in a defined channel toward a sea, lake, or another river.

ROCK – Any naturally formed, consolidated or unconsolidated material (but not soil) consisting of two or more minerals.

RUNOFF - The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff.

SALINE (adj) - Salty; containing dissolved sodium chloride.

SAND - A rock or mineral particle in the soil, having a diameter in the range 0.52 - 2mm.

SEDIMENT - Solid fragmental material that originates from weathering of rocks and is transported or deposited by air, water, or ice, or that accumulates by other natural agents, such as chemical precipitation from solution or secretion by organisms, and that forms in layers on the earth's surface at ordinary temperatures in a loose, unconsolidated form: (b) strictly solid material that has settled down from a state of suspension in a liquid.

SEDIMENTARY ROCK - A rock resulting from the consolidation of loose sediment that has accumulated in layers; e.g., a clastic rock (such as conglomerate or tillite) consisting of mechanically formed fragments of older rock transported from its source and deposited in water or from air or ice; or a chemical rock (such as rock salt or gypsum) formed by precipitation from solution; or an organic rock (such as certain limestones) consisting of the remains or secretions of plants and animals.

SEISMIC – Pertaining to an earthquake.

SILT (soil) - (a) A rock or mineral particle in the soil, having a diameter in the range 0.002-0.005 mm; (b) A soil containing more than 80% silt-sized particles, less than 12% clay, and less than 20% sand.

SITE - Area(s) where a hazardous substance has been deposited, stored, disposed, or placed, or has otherwise come to be located. Such areas may include multiple sources and may include areas between sources.

SOIL PERMEABILITY - The characteristics of the soil that enables water to move downward through the profile. Permeability is measured as the distance per unit time that water moves downward through the saturated soil.

Terms describing permeability are:

Very Slow -	less than 0.06 inches per hour (less than 4.24×10^{-5} cm/sec)
Slow -	0.06 to 0.20 inches per hour (4.24×10^{-5} to 1.41×10^{-4} cm/sec)
Moderately Slow -	0.20 to 0.63 inches per hour (1.41×10^{-4} to 4.45×10^{-4} cm/sec)
Moderate -	0.63 to 2.00 inches per hour (4.45×10^{-4} to 1.41×10^{-3} cm/sec)
Moderately Rapid -	2.00 to 6.00 inches per hour (1.41×10^{-3} to 4.24×10^{-3} cm/sec)
Rapid -	6.00 to 20.00 inches per hour (4.24×10^{-3} to 1.41×10^{-2} cm/sec)
Very Rapid -	more than 20.00 inches per hour (more than 1.41×10^{-2} cm/sec)

(Reference: U.S.D.A. Soil Conservation Service)

SOIL REACTION - The degree of acidity of alkalinity of a soil, expresses in pH values. A soil that tests of pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as:

Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 to higher

SOIL STRUCTURE - The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are - platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

SOLVENTS - A substance, generally a liquid, capable of dissolving other substances.

SOURCE - Any area where a hazardous substance has been deposited, stored, disposed, or placed, plus those soils that have become contaminated from migration of a hazardous substance. Sources do not include those volumes of air, groundwater, surface water, or surface water sediments that have become contaminated by migration, except: in the case of either a groundwater plume with no identified source or contaminated surface water sediments with no identified source, the plume may be considered a source.

STONE - A general term for rock that is used for construction, either crushed for use as aggregate or cut into shaped blocks as dimension stone.

STRATIFIED - Formed, arranged, or laid down on layers or strata; especially said of any layered sedimentary rock or deposit.

STRATIGRAPHIC UNIT - A body of strata recognized as a unit for description, mapping, or correlation.

STRUCTURAL - Of or pertaining to rock deformation or to features that result from it.

SURFACE WATER - All water exposed at the ground surface, including streams, rivers, ponds, and lakes.

SWALE - A slight depression, sometimes swampy, in the midst of generally level land.

SWAMP - An area intermittently or permanently covered with water, having shrubs and trees but essentially without the accumulation of peat.

THREATENED SPECIES - Any species which is likely to become an endangered species within the foreseeable future throughout all or significant portions of its range.

TIME (geologic) - See Figure Gl.1.

TOPOGRAPHY - The general conformation of a land surface, including its relief and the position of its natural and man-made features.

TSUNAMI - A great sea wave produced by a submarine earthquake or volcanic eruption (commonly and erroneously known as a "tidal wave").

TUFF – A general term for all consolidated pyroclastic rocks.

UNCONSOLIDATED - (a) Sediment that is loosely arranged or unstratified, or whose particles are not cemented together, occurring either on the surface or at depth. (b) Soil material that is in a loosely aggregated form.

UNDULATING (geomorph) - (a) A landform having a wavy outline or form. (b) A rippling or scalloped land surface, having a wavy outline or appearance.

VALLEY - Any low-lying land bordered by higher ground, especially an elongated, relatively large, gently sloping depression of the earth's surface, commonly situated between two mountains or between ranges of hills and mountains, and often containing a stream or river with an outlet. It is usually developed by stream or river erosion, but can be formed by faulting.

VEIN (intrusive rock) - A thin, sheetlike igneous intrusion into a fissure.

VESICLE - A small cavity in an aphanitic or glassy igneous rock, formed by the expansion of a bubble of gas or steam during the solidification of the rock.

VITRIC – Said of pyroclastic material that is characteristically glassy; i.e., contains more than 75% glass.

GLOSSARY OF TERMS (Concluded)

VOLCANO - A vent in the surface of the earth through which magma and associated gases and ash erupt; also, the form or structure, usually conical, that is produced by the ejected material.

WASTE DISPOSAL SYSTEM - An excavation in the ground receiving wastes which functions by allowing fluids to seep through its bottom, sides, or both, including cesspools, septic tanks, and seepage pits.

WATER TABLE - The upper limit of the portion of the ground that is wholly saturated with water; the surface on which the fluid pressure in the pores of a porous medium is exactly atmospheric.

WETLANDS - Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

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APPENDIX A

OUTSIDE AGENCIES CONTACTED

APPENDIX A

OUTSIDE AGENCIES CONTACTED

State of Hawaii
Department of Health
Environmental Management Division
Safe Drinking Water Branch
919 Ala Moana Boulevard
Honolulu, Hawaii 96813
(808) 586-4258

State of Hawaii
Department of Defense
Environmental Officer
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495
(808) 735-4659

State of Hawaii
Department of Defense
Office of the Adjutant General
Contracting & Engineering Officer
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495
(808) 735-3522

State of Hawaii
Department of Land and Natural Resources
Commission on Water Resource Management
Kalanimoku Building, Room 227
1151 Punchbowl Street
Honolulu, Hawaii 96809
(808) 587-0218

State of Hawaii
Office of Environmental Quality Control
Central Pacific Plaza
220 South King Street, 4th floor
Honolulu, Hawaii 96813
(808) 586-4185

OUTSIDE AGENCIES CONTACTED (Continued)

R. M. Towill Corporation
420 Waikamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
(808) 842-1133

Hawaii Air National Guard
Environmental Management Office
154th Civil Engineering Squadron
360 Harbor Drive
Hickam Air Force Base, Hawaii 96853-5517
(808) 449-5711

Agency Information Consultants
1708 Guadalupe
Austin, Texas 78701
(512) 478-8991

State of Hawaii Archives
Iolani Palace Grounds
Honolulu, Hawaii
(808) 586-0329

U. S. Army Corps of Engineers
Pacific Ocean Division
Honolulu District
Fort Shafter, Hawaii 96858
(808) 438-1331

U.S. Department of Agriculture
Soil Conservation Service
Prince Kuhio Federal Building
Honolulu, Hawaii
(808) 541-2600

Hawaii Army National Guard
Fort Ruger, Hawaii
(808) 732-1574

OUTSIDE AGENCIES CONTACTED (Concluded)

U.S. Fish and Wildlife
Pacific Islands Office
P. O. Box 50167
Honolulu, Hawaii 96850
(808) 541-2749

National Oceanic & Atmospheric Administration (NOAA)
National Fisheries Service
2570 Dole Street
Honolulu, Hawaii 96822-2396
(808) 943-1221

State Department of Transportation, Airports Division
Kahului Airport
Kahului, Maui 96732
(808) 872-3808

U.S. Department of the Interior
U.S. Geological Survey
Branch of Distribution
Box 25286
Denver Federal Center, Bldg 810
Denver, CO 80225

County of Maui
Planning Department
200 South High Street
Wailuku, Hawaii 96793
(808) 243-7735

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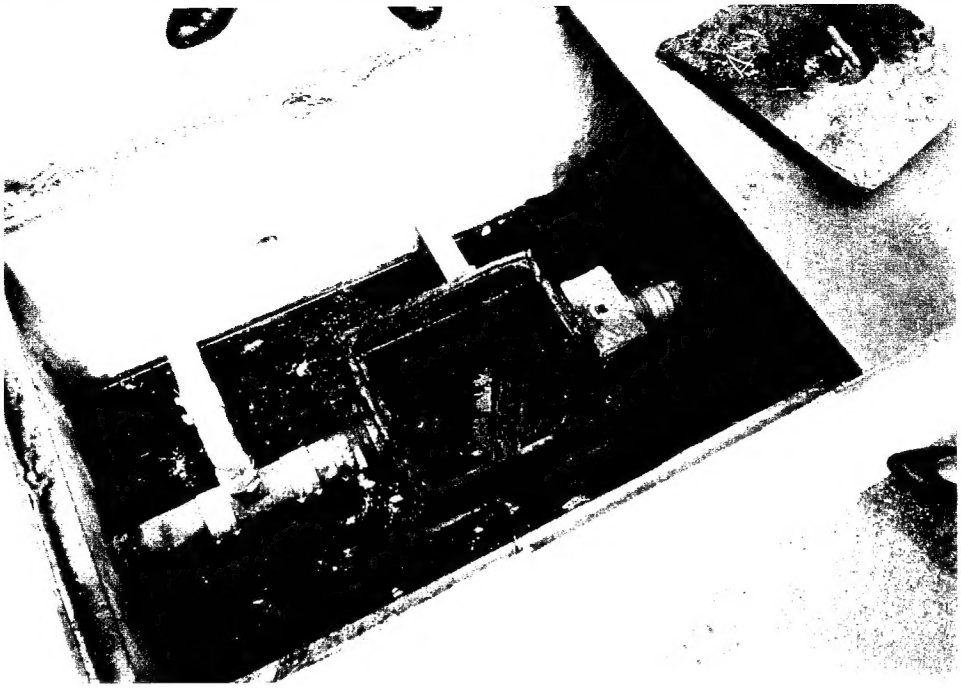
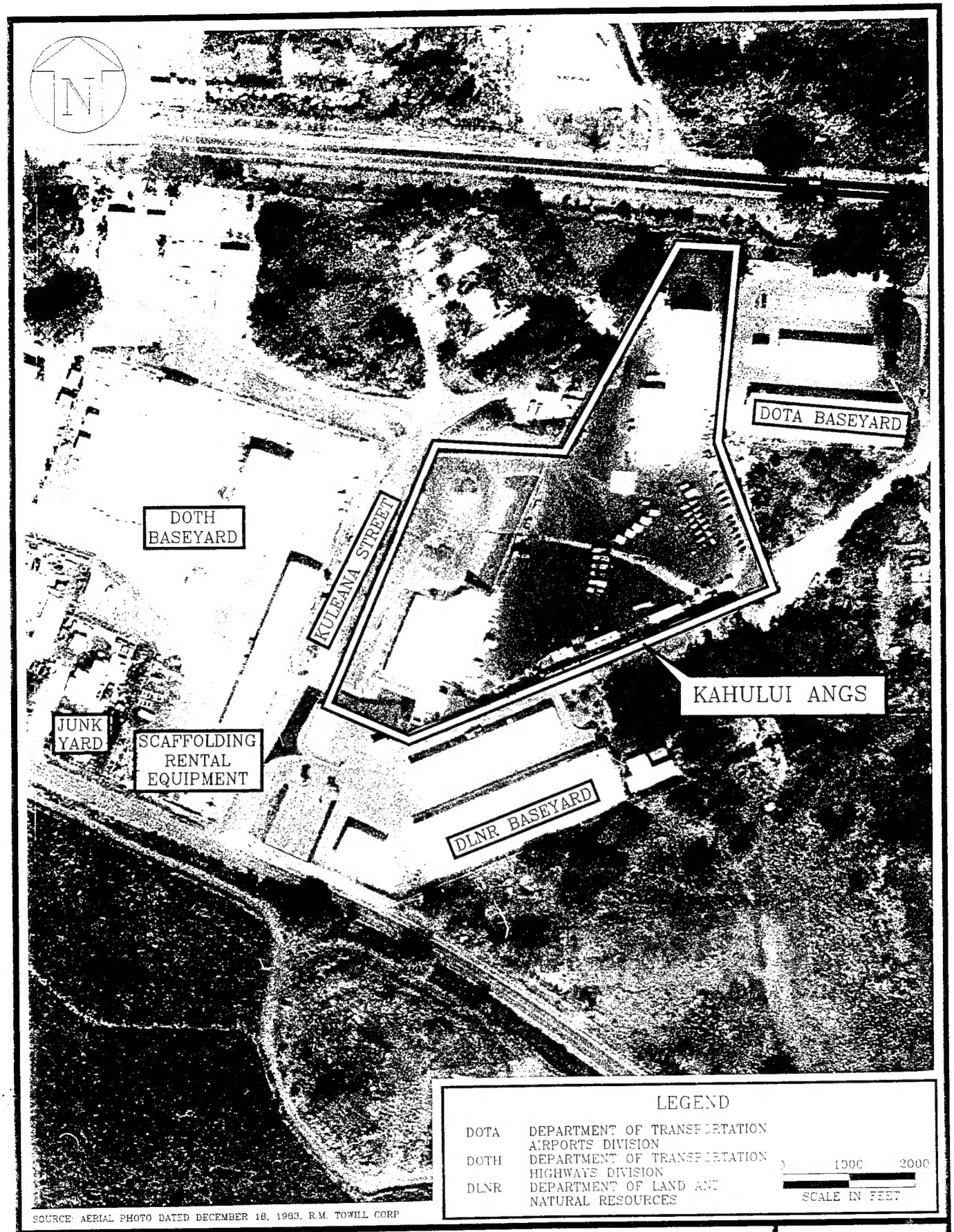
APPENDIX B

PHOTOGRAPHS



1. Deteriorated oil/water separator near Building 502.

2. View of discolored drainage swale bisecting the Station from west to east.



SOURCE: AERIAL PHOTO DATED DECEMBER 18, 1993, R.M. TOWILL CORP

APPENDIX B

R KAHALUI DEC93

KAHULUI ANGS AND ADJACENT
LAND USE
292nd Combat Communications Squadron
Hawaii Air National Guard
Kahului, Maui, Hawaii

OPTECH
OPERATIONAL TECHNOLOGIES CORPORATION

JANUARY 1995